A CROSS-SECTIONAL STUDY OF EXECUTIVE FUNCTIONING AND QUALITY OF LIFE AFTER SUBARACHNOID HAEMORRHAGE.

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DECLARATION

This thesis has been composed by myself and the work described herein is my own.

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INTRODUCTION

Subarachnoid haemorrhage (SAH) is a relatively rare condition but its consequences can be devastating. Over the past 20 years surgical techniques to clip aneurysms, the primary cause of SAHs, have advanced greatly and many patients now go on to make good neurological recoveries. Despite this a significant proportion of these patients continue to experience difficulties in their everyday lives, and a reduction in their overall quality of life. The reasons for this are poorly understood. The purpose of this dissertation is to explore some of these issues and to see whether some light can be shed on the apparent discrepancy between neurological and functional outcome following SAH.

In the introduction I will take the opportunity to explore some general issues surrounding SAH and its treatment, before moving on to consider the consequences of SAH on cognitive functioning, executive functioning, and psychosocial functioning including quality of life. The relationship between these variables and acute events (e.g. hydrocephalus) at the time of the SAH will be examined, and the limited evidence regarding the relationship between these variables reviewed. I will then be better placed to hypothesise why for some patients a discrepancy exists between neurological and functional outcome, and to introduce the present study which aims to test some of these hypotheses.

1. Some Background Information On SAH

SAHs may account for some 8 to 10 percent of all strokes (Mendelow 1992) and as such are relatively rare compared to some other cerebro-vascular accidents(CVAs). The incidence of aneurysmal SAH is found to be some 10 to 16 per 100,000 population annually (Clinchot et al 1994), although Inagawa 1997 found an incidence of 32 per 100,000 annually with a mortality of approximately 50% at 1 month post ruptured aneurysm. In Scotland, for example, this translates into 500 to 800 new cases of SAH per year, and as around half of these individuals survive this means that there are thousands of people in Scotland who have had a SAH.

If we take a hypothetical case, this may help us to illustrate some of the risk factors, onset, course, etc. of SAH. She (as women are more at risk) is likely to be 50 to 60 years of age (Knuckley & Stokes 1981), smokes (National Stroke Association), has high blood pressure (Vermeulan & van Gijn 1990), drinks more than she should (Klatsky et al 1989), and has a poor diet (Caplan et al 1986). Like one in five people our mythical patient may have a 'warning bleed' a matter of days or weeks prior to the ruptured aneurysm. This is generally characterised by a sudden agonising headache which may also be accompanied by nausea and vomiting. This is so severe she is likely to seek medical attention (Drake 1988), but like over ninety percent of patients she will not be immediately referred to a neurosurgical unit but rather a diagnosis such as sinusitis will be made (Tolias et al 1996). The consequence of this, is that if and when she does reach hospital following a second and more substantial bleed, her clinical grade is likely to be lower which is significant because clinical grade at admission has been linked with outcome from SAH.

The aneurysm itself is due to an abnormal dilation of a blood vessel within the network of cerebral arteries which is due to a defect in the blood vessel wall. Such a defect can occur for a number of reasons e.g. trauma, infection, but the majority of defects are congenital. These intracranial aneurysms are the most common cause of sub-arachnoid haemorrhage, and generally only aneurysmal SAH will be considered in this study.

When the aneurysm actually ruptures she is likely to experience a sudden massive headache and perhaps loss of consciousness (in approximately 50% of cases) with seizures, dysphasia, and motor disturbances being less frequent. These disturbances of consciousness are thought to result from an abrupt rise in intracranial pressure (ICP) and a temporary cessation of cerebral perfusion. If a single aneurysm this is most likely to be located in the internal cartoid artery, and then in decreasing order of frequency, the anterior communicating, middle cerebral and basilar artery which together account for some 95 % of all bleeds (Locksley 1966). She is now at risk from a number of complications which will result in further insults to her brain. I will consider these below, but for now what are her chances of surviving the initial aneurysm? Kilner (1988) reports that 8 to 15 percent of people who suffer aneurysms die before receiving medical care and overall some 20 to 37 percent of patients die within the first 48 hours. If left untreated Lindsay (1992) reports that 60 to 70 percent of patients with SAH will die within one year. Thus if our patient is to survive it would seem obvious that she needs treatment and needs it quickly. In most cases this takes the form of a craniotomy to clip the ruptured aneurysm (or aneurysms) and remove any haematoma that may be present. The operation itself is not without its risks and I will return to this

in more detail later, but for now I would like to review the range of pre and post operative complications our patient may be subject to.

2. Pre And Post Operative Complications

There is a wide range of potentially life threatening complications subsequent to a ruptured aneurysm including intracerebral haematomas (which accounts for some 5 percent of all deaths from aneurysm rupture), cardiac arrhythmias, re-bleeding of the aneurysms, hydrocephalus, and vasospasm. I wish to concentrate on the last 3 as these are the most common preventable or remediable complications.

2.1 Re-bleeding

It has been found that some 60 percent of patients re-bleed within the first year post aneurysms, if it is left untreated, and of these some two thirds die. The patient is at maximum risk of re-bleeding 4 to 9 days post bleed according to Lindsay (1992), although it is now recognised that many early re-bleeds are missed and it is thought that the risk may decay exponentially from the start. This would suggest that early intervention is imperative but as we shall see things are not quite that simple. In addition, a number of drugs have been identified which reduce the risk of re-bleeding

but these drugs have been linked with an increased risk of other complications such as vasospasm and hydrocephalus and as a result are little used.

2.2 Hydrocephalus

It has been found that hydrocephalus occurs in some 20 percent of patients within 24 hours of their bleed (van Gijn et al 1985). Hydrocephalus typically leads to raised I C P which may limit cerebral blood flow and cause brain shift, both of which may contribute to cerebral ischaemia. In the majority of cases once detected hydrocephalus can be relatively easily treated by lumbar puncture or ventricular drainage.

2.3 Vasospasm

Delayed cerebral ischaemia occurs in some 20 to 40 percent of SAH patients 4 to 10 days post bleed and clinically presents as neurological deterioration involving a reduced level of consciousness and focal neurological signs and it is estimated that some 25 to 50 percent of patients who develop cerebral ischaemia die (Pickard et al 1989).

While hydrocephalus and re-bleeding can lead to cerebral ischaemia by raising ICP, vasospasm is often quoted as the principal cause of delayed ischaemia. Vasospasm refers to the narrowing of the major cerebral arteries and some 40 percent of patients experience angiographic vasospasm within 20 days of their aneurysms (Popovic et al 1989) and of these approximately half will develop ischaemic consequences (Pickard et al 1992). It has been suggested that early operation would reduce the number of patients experiencing vasospasm, but it may be that, at least for some patients changes

have been set in motion, which result in ischaemia, which cannot be reversed by early operation (Inagawa 1989) and Drake (1978) suggested that operating in the acute stage of SAH may increase the risk of vasospasm and hence ischaemia. More recently a large scale randomised trial has shown that the drug nimodipine (a calcium channel blocking drug) significantly reduces the risk of delayed ischaemia and also leads to less patients being classified as having made a bad outcome -19% compared to 31% in the placebo group (Pickard et al 1989).

The immediate consequences of acute complications seem clear, that is they markedly increase morbidity and mortality and as such everything must be done to minimise their occurrence and should they occur, to manage them effectively. It has often been hypothesised that the presence of complications, especially vasospasm, would lead to a poorer long term outcome on the basis that the brain has suffered additional insult. The research, however, does not always clearly support this view, especially when cognitive outcome is considered, and I shall explore this in more detail later when I review the studies looking at cognitive and psychosocial outcome following SAH.

3. Surgery For Aneurysmal SAH

Surgeons have been operating on aneurysmal SAH for over 40 years prior to which the condition was treated conservatively with very high mortality rates. The favoured technique is craniotomy to allow surgical clipping of the ruptured intracranial aneurysm, although some new techniques (e g endovascular coils) are gaining in popularity. Initially, the trend was towards early operation as it was felt that this would minimise the risk of many of the complications described above but the mortality was

very high. Graf (1955) reports that 77% of patients operated on within the first two weeks following the initial aneurysms died, compared to 29% of those operated on beyond this time. Until the 1970s delayed operations were the standard but a number of new surgical advances, including improved anaesthetic techniques, the introduction of the operating microscope into aneurysmal surgery, and spring loaded clips began to reduce the delay, with the result that by the late Seventies research was showing far less mortality from early operations than in the past (e.g. Sano & Saito 1978) although mortality remained less for later operations. When overall mortality rather than just operative mortality is considered, most studies have shown no difference between early and late operations. The International Collaborative Study On The Timing Of Aneurysm Surgery (Haley et al 1992) showed that very early (0 to 3 days) surgery did reduce re-bleeding but not vasospasm, and that patients were most at risk if operated on 7 to 10 days post aneurysm. These results, combined with the use of nimipodine to combat vasospasm, have resulted in very early (0-3 days) or early (3-7 days) operations being standard practice although it is becoming increasingly clear that other factors, such as age and clinical grade, are important considerations when deciding when to operate. Recent studies have reported good outcomes in some 81 to 87 percent of patients who undergo early operation (Vajda et al 1990, Saveland et al 1993).

4. Outcome and SAH

As we have just seen a significant percentage of people now survive a SAH and many of those who undergo surgery go on to make what neurosurgeons term a 'good recovery'. In general this does not necessarily mean that the individual has made a full

recovery, but rather that there is an absence of major neurological deficits and the patient's condition falls into the category of good recovery as defined by the Glasgow Outcome Scale (Jennett & Bond 1975) which is as follows:-

"Resumption of normal life, even though there may be minor neurological or psychological deficits. Return to work is unrealistic as a main criterion of outcome, because it may lead to unrealistic expectations, and is very sensitive to local economic and cultural situations. Furthermore, some patients with considerable disability may be fully employed, either because of modifications of the workplace, a job which is compatible with a particular disability, or because an employer is being generous in providing what is effectively, sheltered employment. Other aspects of social outcome should be included in the assessment here, such as leisure activities, and family relationships" (Truelle, Van-Zomeren, de-Barsy et al 1992).

This obviously represents an attempt to broadly define outcome on a fairly global basis and as such is relatively crude as its creators would freely admit (Jennett et al 1981). The result of this is that it leaves room for a finer grained discussion of outcome from a variety of perspectives, including cognitive outcome, psychosocial outcome, and quality of life following SAH. In the following sections I would like to review some of the literature examining recovery from SAH from these perspectives. Regarding cognitive outcome, I hope to highlight the possible presence of executive dysfunction in a significant proportion of SAH patients and the probable consequences of this. This will necessitate a foray into the more general debate regarding the nature of executive deficits and their consequences.

4.1 General Outcome And SAH

While SAH still carries a significant mortality rate it is becoming increasingly clear that if the individual survives the initial bleed and survives past the immediate post operative period, as some 50 to 60 percent of all SAH patients do, then most will go on to make good neurological recoveries. For example, McKenna (1989) reports that only 13% of their sample had neurological deficits, while Vilkki et al (1989) studied a consecutive series of 118 patients who had ruptured aneurysms and report that by one year post operation 10 had died and of the remaining 96 out of 108 who could be contacted, 79 showed no or only minimal disability when rated using the Glasgow Outcome Scale. It is clear then that for the majority of SAH survivors major neurological difficulties are not an issue and if deficits do exist they are likely to be more subtle and lie in the cognitive and psychosocial domains.

4.2 Cognitive Deficits After SAH

Over the past 10 to 15 years there has been a growing body of evidence regarding cognitive difficulties following aneurysmal SAH. This literature has tended to cover a number of themes, including the nature and extent of cognitive deficits, their relationship with pre and post operative complications, the relationship between site of aneurysms and information from neuroimaging, and the cognitive deficits that may exist despite a "good recovery". More recently, there has also been some interest in the question of executive dysfunctioning following SAH and the possible consequences of this. While not mutually exclusive, I propose to examine each of these broad themes in

turn to gain a better understanding of the relationship between aneurysmal SAH and cognitive deficits.

4.3 Nature And Extent Of Cognitive Deficits .

By far the majority of studies demonstrate clear cognitive deficits in a significant number of aneurysm patients. In one of the earlier papers Ljunggren (1985) examined 118 patients who had made a "good neurological recovery" an average of 3.5 years post bleed (range 14 months to seven years). These subjects took part in a neuropsychological assessment and for each subject the number of test scores that fell below pre-set criteria for cognitive dysfunction was calculated. If 0 to 1 test scores indicated cognitive dysfunction then they were classified as having "no or mild cognitive disturbances", 2 to3 scores below the pre-set criteria classified as "moderate cognitive disturbances" and 4 or more test scores termed "marked cognitive disturbances". The authors report only one patient who was totally free of signs of cognitive impairment while 53 percent of the sample fell into the category of marked cognitive disturbance. This result is echoed in the work of other authors. Tidswell et al 1995 examined a largely unselected group of 37 patients who had undergone surgery for the repair of a single aneurysm. As a whole, the group showed no difference between pre-morbid and current estimates of intellectual ability but when individual patient profiles were examined, some 65 percent of the sample had at least one test score two or more standard deviations below the mean.

These studies raise a number of points. Firstly, the Tidswell study demonstrates that when we analyse the data from the subject group as a whole, we often find little or no

significant differences from either normative data or controls but when we examine individual patient profiles we often find a significant proportion of aneurysm patients who show clinically significant cognitive deficits, where "clinically significant" is generally taken to mean a score two of more standard deviation below an age corrected mean. For example, Vilkki et al 1989 found no differences in group means across a range of neuropsychological tests between a group of SAH patients with no evidence of infarct on C T and a group of orthopaedic controls. In a later paper involving the same patients (Vilkki et al 1990) 40 percent of this group were classified as achieving a deficient outcome due to poor subjective mental status and 8% had failed to return to work one year after their SAH. This would appear to suggest that comparing group means obscures a significant amount of cognitive and psychosocial deficits.

There are perhaps two counter arguments to this view, firstly, at a practical level looking at deviations from the norm across a fairly large test profile inevitably leads to false positives which must be borne in mind during analysis or, at least, in the interpretation of the results. In addition, there is the problem of assigning what is a clinically significant deviation, and who is the relevant comparison group for SAH patients - normative data from the general population or data from groups who have underwent an equally traumatic experience? That is, are we interested in the absolute level of impairment in comparison with the general population, or relative impairment in comparison with other patient groups? This issue has led to some debate within the SAH literature looking at outcome, regarding the appropriate control group if any.

The latter position is exemplified in the paper by McKenna et al 1989, a study examining 70 SAH patients without neurological deficits and 50 myocardial infarction (MI) controls. They report using an M I control group as they are interested in whether SAH causes altered brain function in the absence of neurological damage but believe this may be confused with the patient's psychological reaction to the trauma. By using a M I control group they suggest they are comparing the SAH patients with "a patient group whose illness would not include brain injury or disease, but would infer the same type of psychological trauma" (p. 365) and as such they remove this possible source of confusion. They report that the results for both groups compared well with test norms on tests such as the Weschler adult intelligence scale (W A I S) and the Recognition Test For Faces And Words and there were no significant differences between the SAH patients and M I controls with the exception that the M I group had a significantly higher Performance I Q and the SAH group on average achieved more categories on the Wisconsin Card Sort Test. The authors suggest "these results lead us to conclude that where the medical and surgical course of SAH is uncomplicated, patients can expect to recover with no permanent or significant reduction in their intellectual ability". (page 365)

With regards to this study and the positions it outlines, I would like to make 3 points:-

1. The assumption that M I patients do not have brain injury is questionable. This point is raised by Ogden et al (1993), who on consideration decided not to use an age matched control group due to the difficulty of finding a group who survived a disorder equally sudden and life threatening, but carried no risk of brain injury. M I patients who are perhaps the most the favoured group were discounted for two reasons - the

possible presence of undiagnosed cerebral infarct and the greater incidence of men than women (the opposite to what is found in SAH).

2. McKenna et al (1989) adopt the position that any cognitive and psychosocial difficulties present after SAH, may at least in part, be attributable to the psychological consequences of the trauma rather than being injury per se. Therefore, by comparing them with a group with no brain injury but similar trauma, they appear to assume that any differences between the groups will be the product of the brain injury. This would appear to suggest that brain functioning and the psychological consequences of trauma are neatly dissociable, and by removing one we are left with the results of the other. I would suggest that such a position is overly simplistic and if we look at more recent models of recovery and functioning after brain injury, then psychological effects are seen to play an important modifying role and as such are not easily dissociable from the injury itself. For example, Moore and Stambrook (1992, 1995) in a number of recent papers focusing on traumatic brain injury (T B I), which I feel are pertinent here, suggest "that long lasting cognitive, behavioural, emotional, psychiatric, and inter-personal after effects of T B I may create a real life learned helplessness with consequent deficits in coping and altered locus of control belief" (page 109, 1995). These cognitive beliefs, they argue, play an important moderating role in the recovery from brain injury, with a real danger of survivors overgeneralising their impairment due to their negative beliefs which results in sub optimal outcome. In such a model it is clearly impossible to dissociate the injury itself from its psychological and psychosocial consequences.

3. The third point concerns the choice of neuropsychological tests used to detect cognitive deficits. Summed scores from test batteries, as we have already seen, are notoriously poor at discriminating the brain injured from even normal controls and may hide a range of cognitive deficits. As Teuber (1969) points out "one must never misconstrue a normal intelligence test result as an indication of normal intellectual status after head trauma, or worse, as indicative of a normal brain; to do so would be to commit the cardinal sin of confusing absence of evidence with evidence of absence". This is exactly what McKenna et al (1989) do when they report IQ scores.

In addition, they only include a recognition memory test, rather than tests of visual and verbal immediate and delayed recall which are known to be highly sensitive to the effects of brain trauma (Stuss et al 1985) and, as we shall see, perhaps particularly apt for SAH patients. Also, the Advanced Progressive Matrices, another test in their battery is known to have only limited usefulness in screening for brain damage e.g. most of a group of patients with early Alzheimer's disease having scores in the normal range (Grady et al 1988). Thus, even if there were significant group differences in aspects of brain functioning in the SAH group and M I controls, the neuropsychological test battery employed was likely to miss them.

To sum up, the vast majority of studies that use appropriate test batteries show a significant level of cognitive dysfunction among SAH patients (even amongst those with no neurological deficits), in comparison with normative data. It is difficult to tease out to what extent this cognitive dysfunction is a direct consequence of the brain injury as opposed to the psychological reaction to the event. At the end of the day, such a distinction may be relatively meaningless as following a SAH, one cannot dissociate

the psychological reaction from the brain injury and as such, the two are inextricably intertwined. Having shown that cognitive deficits are relatively common, I would now like to move on to consider their nature and duration.

Summarised in the tables below are the neuropsychological assessments and subsequent cognitive deficits reported in a number of recent studies of SAH patients. This table is not intended to be exhaustive, but to give a flavour of the type of cognitive deficits commonly found.

AUTHORS	NEUROPSYCHOLGICAL ASSESSMENT BATTERY
Hutter et al 95	Wechsler Intelligenz Prufung (WIP) - modified intelligence scale d2 (Similar to Bourdon Wiersma Dot Cancellation Test) LPS-LD - logical thinking LPS-RV - spatial cognition IST-ME - German standard memory test Benton Visual Retention Test Stroop Test Token Test Wiener Determinationsgerat - choice reaction time
Tidswell et al '95	National Adult Reading Test (NART) WAIS Sub-tests- Similarities, Block Design, Picture Arrangement Wisconsin Card Sort Test Verbal Fluency Warrington Recognition Memory Test Wechsler Memory Scale Sub-test- Logical Memory Calev recognition - recall test Line bisection
Ljunggren et al '85	SRB:1 - Swedish standard verbal intelligence scale Paired Associates Benton Visual Retention Test Graham-Kendall memory for designs WAIS Sub-test- Block Design Bourdon Wiersma dot test Trail Making Test Wisconsin Card Sorting Test
Ogden et al '93	Oral Selective Reminding Test Rey Complex Figure Test Warrington Recognition Memory Test Short Token Test NART Graded Naming Test Minnesota Test for the Differential Diagnosis of Aphasia WAIS-R Sub-tests- Vocabulary, Similarities, Comprehension, Digit Span, Picture Completion, Block Design, Picture Arrangement and Digit Symbol Line Bisection Trail Making Test A & B Modified Wisconsin Card-Sorting Test

TABLE 1: ASSESSMENT BATTERIES EMPLOYED IN 4 STUDIES EXAMINING COGNITIVE DEFICITS AFTER SAH.

AUTHORS	PATIENT GROUP	TIME POST SURGERY	CRITERION FOR COGNITIVE DEFICITS	COGNITIVE DEFICITS (% of total sample assessed)			
Hutter et al '95	58 aneurysmal SAH patients rated as GOS = I (Good) or II (Fair)	1 - 5 years	2 or more standard deviations below mean, or below test cut-off.	VISUAL STM VERBAL LTM REACTION TIME CONCENTRATION LANGUAGE			46% 28% 31-65% 5-13% 11%
Tidswell et al '95	37 aneurysmal SAH patients-'unselected'	6 - 45 months mean = 26.8 mths	2 or more standard deviations below the mean.	MEMORY & EXECUTIVE FUNCTIONS EXECUTIVE FUNCTIONS ALONE MEMORY ALONE			32% 19% 14%
Ljunggren et al '85	40 SAH patients who had made a 'good neurological recovery'	14 months - 7 years mean = 3.5 years	"Deviations from expected performances to indicate cognitive dysfunction were set to exceed standards normally used in clinical practice" p. 674	VERBAL & NON-VERBAL STM VERBAL MEMORY ALONE NON-VERBAL MEMORY ALONE ANY 'INSUFFICIENT MEMORY FUNCTIONS' ABSTRACT & CONCEPTUAL THINKING COGNITIVE FLEXIBILITY VISUO-SPATIAL DEFICITS INFORMATION PROCESSING & ATTENTION			38% 18% 28% 83% 48% 45% 35% 28%
Ogden et al '93	66 SAH patients . 58 GOS = I, 6 GOS = II, 2 GOS = III	12 months	2 - 3 standard deviations below the mean = 'moderately impaired' 3 or more standard deviations below the mean = 'severely impaired'		MOD	SEV	TOT
				CONCENTRATION	5%	0%	5%
				VERBAL MEMORY	13%	5%	18%
				NON-VERBAL MEMORY	17%	30%	47%
				WAIS-R VERBAL TESTS	10%	3%	13%
				WAIS-R PERFORMANCE TESTS	19%	8%	27%
				MTDDA	7%	0%	7%
				TRAILS A & B	41%	35%	76%
				MODIFIED CARD SORT	3%	15%	18%

TABLE 2: COGNITIVE DEFICITS & SAH; THE FINDINGS OF 4 STUDIES

From the above tables, it may at first glance appear that at least some SAH patients display a wide range of cognitive deficits, with little consistency across patients or studies. But when we look more closely at the results reported, and tests used, a pattern of relatively common deficits appear to exist which is perhaps masked by the different terminologies used in these studies. The clearest area of cognitive deficits is in memory, with these studies reporting that between 46 and 83 percent of their samples have some sort of memory difficulty, with visual memory problems appearing the more prominent. Ljunggren et al (1985), reports 35% had visual spatial deficits and Ogden et al (1993) found that over 11 percent of their sample were two or more standard deviation below the mean on the visual spatial task block design. Behind the rag bag of terms "reaction time", "concentration", "information processing and attention" hides a number of additional cognitive deficits. Three of the studies show impaired speed of information processing in about 50 percent of their sample, - Ljunggren et al (1985) and Hutter et al (1995) using the Wiersma Dot Cancellation Test and Ogden et al (1993) using Digit Symbol. Included under these headings are also more complex tasks requiring sustained attention, speed of information processing, and cognitive flexibility, notably a choice reaction time task (Hutter et al 1995) and Trail Making A and B (Ljunggren et al 1985 and Ogden 1993). Some 31 to 76 percent of subjects are found to perform poorly on these more complex tasks. Although not reported as such in these studies, these tests are known to be sensitive to frontal executives deficits. Further evidence of executive dysfunctioning comes from Ogden et al (1993), where 18 % of their sample were impaired on the Modified Card Sort Test while Tidswell et al (1995) found some 51% of their sample to be impaired on the Wisconsin Card Sort and/or Word Fluency. In contrast, these studies tend to show fewer individuals with language / verbal impairments.

Thus, these studies show that following SAH memory and various aspects of executive functioning are commonly impaired. Speed of information processing is affected in a significant proportion of individuals and some may also show visuo- spatial deficits, whilst the majority survive with their language functions intact. This is echoed in Hutter and Gilsbach (1993) who in reviewing a number of studies examining cognitive deficits after SAH conclude "in nearly all studies, SAH patients were especially impaired in functions that are related to cognitive speed, concentration capacity, and memory functions" (page 1003) and they liken this cognitive sequlae to that found after mild closed head injury.

In addition to the presence and nature of cognitive deficits, a related question has been in what ways, if any, do these deficits alter over time. This question has been addressed by a number of researchers. Stenhouse et al (1991) report a group of 27 patients, with anterior communicating artery aneurysms, who were assessed 12 to 84 months (mean = 4.5 years) post bleed and found there to be no significant correlation between level of deficit and time post surgery. Ljunggren et al (1985) similarly found no relationship between levels of cognitive disturbance and length of time since aneurysm rupture in a group assessed 14 months to 7 years post bleed (mean=3.5 years). These, and other similar results, would appear to suggest little or no change in cognitive function over time, which is perhaps rather gloomy as one would hope to see some improvement over time. The criticism, however, is that the average length of time post bleed is rather long (3.5 to 4.5 years) and as such, one would expect the groups to be relatively stable due to a lack of contrast between individuals whom are early and late post aneurysm. This question is most thoroughly addressed by Ogden et al who in a

longitudinal study assessed the same group of 89 aneurysms patients as in patients, at 10 weeks, and 12 months post aneurysms. They suggest that retrospective studies may suffer from a number of selection biases including patients still under medical care and those not back at work, which may bias the sample towards the presence of cognitive deficits. They report that their sample improved significantly across all the assessments on 7 out of 8 memory tests administered, and on 6 out of 15 measures of other aspects of cognition across the 2 follow-up assessments (10 weeks and 12 months). Overall, they found rapid improvement in memory over the first 10 weeks, which slowed but continued until 12 months but on a group of tests requiring speed of information processing, mental flexibility, and sustained attention (Digit Symbol, Trail Making, Modified Wisconsin) they found that a substantial percentage of their sample showed moderate to severe impairments at 10 weeks and this had not changed significantly by 12 months post aneurysms. For example, only 46% of their sample showed no impairment on Trails B at 10 weeks and this had only risen to 56% at 12 months. Whether their sample showed any improvement after the 12 months is not known, but this result in conjunction with those discussed earlier, suggests that there are a group of cognitive deficits that can be detected soon after the SAH which persist over many years and may in fact be permanent. Although, if and how these deficits altered between 12 months post aneurysms and the longer term, say 5 to 6 years, has not been adequately tested.

4.4 Acute Factors And Cognitive Deficits; Is There A Relationship?

Given that cognitive deficits are relatively common post SAH, it would seem to make intuitive sense that the nature and extent of cognitive deficits are related to the

presence of pre and post operative complications, as these are indicative of additional insult to the brain and possibly delayed cerebral ischaemia, and that the cognitive outcome varies to some extent with the location of the aneurysms. The evidence in support of both these positions is as we shall see mixed, as is the evidence to support other possible predictors of cognitive outcome.

4.41 Age

One of the more robust predictors of cognitive impairment following SAH is age at the time of the bleed, with a number of researchers showing greater cognitive deficits in older patients (e.g. Hutter and Gilsbach 1993, Ogden et al 1993), but even here some researchers have failed to replicate these results (e.g. Stenhouse et al 1991).

4.42 Clinical Grade At Time Of Admission

In most neurosurgical units SAH patients are routinely graded on the Hunt and Hess scale (Hunt & Hess 1968) at time of admission and at various points throughout their stay. This scale ranges from grade 0 - no haemorrhage, asymptomatic aneurysms, through to grade 5 - coma, decerebrate rigidity, and moribund appearance. Clinical grade at admission has been reliably linked both with mortality and functional recovery from SAH (Castle et al 1993). In addition, it has also been shown to be related to later cognitive deficits (e.g. Ogden et al 1993, Richardson 1991) although Stenhouse et al (1991) found no relationship between clinical grade prior to operation and subsequent cognitive deficits and Hutter and Gilsbach (1993), found no relationship between Hunt and Hess grade at admission and cognitive function 1 to 5 years post aneurysm.

4.43 Blood on C T

The extent and thickness of blood on acute C T scans is often taken as a proxy measure of severity of initial bleed and as such, we may expect this to be correlated with future cognitive deficits. Both Ogden et al (1993) and Hutter and Gilsbach (1993) report a relationship between the location and amount of blood seen on C T and the presence of some cognitive deficits.

4.44 Pre And Post Operative Complications

As discussed earlier the typical SAH patient is at risk of a range of pre and post operative complications. Whilst these complications are a major contributor towards mortality from SAH and cause delayed cerebral ischaemia, their relationship with longer term cognitive and psychosocial outcome is less clear. Hutter and Gilsbach (1993), for example, found no association between severe vasospasm and cognitive deficits 1 to 5 years post aneurysm in a group of 31 patients rated as having a good outcome, while Stenhouse et al (1991) studying a group of 27 patients who had anterior communicating artery aneurysms and made good neurological recoveries, found a strong association between vasospasm and cognitive outcome. For example, 5 out of 6 patients classified as having "pervasive global impairment" had demonstrable signs of vasospasm while only 2 out of 11 cases who had "no measured cognitive impairment" had vasospasm. They conclude "the data reported here add to the accumulating evidence that suggests that vasospasm alone can produce long term cognitive impairment" (page 914).

To complicate matters further, Ogden et al (1993) found no correlation between vasospasm and outcome, while they did find a relationship between ischaemia and hydrocephalus and cognitive performance, at least in the early stages post bleed. In addition, Richardson (1991) reports that only post operative vasospasm was associated with cognitive performance and then only shortly after haemorrhage but, Tidswell et al (1995) found that post operative events were associated with some aspects of cognitive performance and with relatives' reports of symptoms an average of more than two years post bleed.

Is there any way to explain or reconcile these seemingly conflicting results? Firstly, in the majority of studies the number of subjects who displayed the various complications are relatively small and thus they probably lack sufficient power to show small to medium effects. In addition, when and how complications are defined may also have an important effect. Vasospasm by itself is unlikely to directly result in long-term cognitive impairment, although the ischaemia that results from some but not all cases may. Therefore, looking at the effects of delayed cerebral ischaemia directly on cognitive performance may be more profitable than the presence or absence of vasospasm. Also, the limited evidence available would appear to suggest that post operative complications have more impact on subsequent cognitive performance and as such perhaps we should concentrate on these.

4.5 Cognitive Outcome And Site Of Aneurysm

It has often been assumed that the location of the aneurysm will have an impact on any cognitive deficits which are present, with anterior communicating artery aneurysms in particular being associated with memory problems and poorer cognitive outcome in general. The experimental evidence, however, is rather more mixed. Many studies have now failed to find a clear relationship between site of aneurysm and cognitive outcome (Tidswell et al 1995, Romner et al 1989, Ljunggren et al 1985, Richardson 1991,Sonesson 1987, De Sautes 1989), although a smaller number of authors have found a relationship of sorts between aneurysm site and some aspects of outcome. Hutter and Gilsbach (1995) looking at introspective capacities in SAH patients found differences according to aneurysm site. That is, patients with frontal or right parietal lesions were less depressed than patients whose lesions were elsewhere and they also showed less concern about their health. Vilkki et al (1989) looked at the relationship between late C T findings and cognitive performance one year after SAH. The subjects' C Ts were classified as to whether or not infarction was present, the site of infarction if present, and the presence or absence of diffuse damage. Out of their sample of 96 patients, 53 had infarctions and almost all of these were in the territory of the ruptured aneurysm. In this group the study reported that site of infarction was related to specific cognitive deficits, although the presence of diffuse damage was also important. Patients with infarctions in the left lateral M C A area showed problems on a number of language based and verbal memory tests. Those patients with right lateral infarctions and diffuse damage were significantly worse than the other groups on the copy of the Rey Complex Figure, although there were no significant differences for other visual spatial tasks such as Block Design. Furthermore, Vilkki et al (1989) hypothesised that following frontal medial infarctions subjects would have particular problems with inflexible behaviour and habitual responding leading to poor

performance on tests such as Wisconsin Card Sorting Test and Word Fluency, but rather found these difficulties to be associated with diffuse damage.

The question of particularly marked cognitive problems, especially in the area of memory, following anterior communicating artery aneurysms was addressed by Tidswell et al (1995) who compared a group of 20 anterior communicating artery aneurysm patients with 17 patients with aneurysms at other locations. While their population as a whole showed impairment in some aspects of executive functioning and memory, there were no significant differences between the groups. Although it is likely with these sample sizes that more subtle effects would have been overlooked. It is clear, however, that anterior communicating artery aneurysms can relatively rarely result in a severe amnesiac state and it is perhaps this phenomenon that has led to the mistaken assumption that anterior communicating artery aneurysms in general give rise to the most pronounced memory impairments.

Again, perhaps these conflicting findings can, in part, be reconciled. In many studies looking at the effect of site of lesion, the numbers in the different sub-groups are small and as such smaller effects are likely to be missed Vilkki et al (1989), in one of the few studies finding site to be important, did not look at the site of the aneurysm per se but at the site of infarction (if any) one year after the aneurysm. This is a measure not only of the location of the aneurysm but also probably an indication of the severity of the initial bleed and /or the presence of complications resulting in delayed cerebral ischaemia. Even here, the presence of diffuse damage was as important if not more so than the focal infarct. This result echoes the growing body of evidence from larger samples in T B I which show that later neuroimaging is more predictive of cognitive

performance, and while the pattern of focal impairment has some impact the diffuse effects of the injury are more important (Wiedmann et al 1989, Wilson et al 1990). This is the position adopted by Ogden et al (1993) who suggest that the cognitive problems that follow SAH are unlikely to be due to the focal damage or the effects of surgery "but are caused by the diffuse effects of the SAH per se" (page 583). In addition, it is clear that a minority of patients with no focal infarcts or diffuse damage continue to suffer from persistent cognitive and executive deficits. Ruff et al (1994) examining a group of 9 such brain injured patients found evidence of neuropathology using functional neuroimaging (PET). Thus, in the absence of hard neurological evidence it seems likely that there may be functional brain abnormalities which may account for a range of deficits.

4.6 Cognitive Deficits Despite A "Good Outcome"

The range of cognitive sequlae discussed above may be expected among patients who make a less than full recovery but, would we expect such deficits in patients who make "good neurological recoveries" or satisfy the G O S criteria of a "good recovery"? When we look at Table 2 it can be seen that the majority of subjects do fall into these categories and yet a significant proportion of patients display a range of cognitive deficits. It may be that the inclusion of some patients who are making a less than good recovery are colouring the results, although there has long been anecdotal evidence that some SAH patients who make a good recovery do not go on to do as well as expected. This issue was addressed by Hutter and Gilsbach (1993) who asked the question "which neuropsychological deficits are hidden behind a good outcome". That is they examined a group up of 31 patients, 1 to 5 years after their bleed who had been

classified as G O S= 1 at six months post bleed. They found that 54% of their sample scored 2 or more standard deviation below the mean on 3 or more tests with a pattern of deficits as shown below.

PATIENT GROUP	TIME POST SURGERY	CRITERION FOR COGNITIVE DEFICITS	COGNITIVE DEFICITS
31 patients rated as GOS=1 at 6 months post aneurysm	1 to 5 years post aneurysm	2 or more standard deviations below mean, or below test cut-off.	VISUAL STM 53% VERBAL LTM 21% REACTION TIME 28-62% CONCENTRATION 7-16% LANGUAGE 10%

TABLE3: FROM HUTTER & GILSBACH (1993), COGNITIVE DEFICITS DESPITE A GOOD OUTCOME.

When these results are compared with those reported by other authors using more mixed groups of aneurysm patients (see Table 2) there would appear to be little difference, although Ogden et al (1993) did find some relationship between G O S grade and cognitive performance i.e. G O S score at 10 weeks post aneurysm was predictive of a poor performance on 4 scores at 12 months, with poorer G O S being associated with significantly poorer performance on Trails B and the Rey Figure copy and recall. Nevertheless, it is clear that a significant proportion of aneurysm patients display a range of cognitive impairment despite being graded as having made a "good recovery".

Of particular interest within the present study, is the presence and consequences of executive deficits following SAH. The literature reviewed so far would suggest that executive deficits are relatively common following SAH (e.g. Tidswell et al (1995)

found some 51% of their sample to be impaired on the Wisconsin Card Sorting Test and /or Verbal Fluency), even among those making good recoveries, although with the exception of Tidswell, none of the researchers actually use the term executive functioning or deficits. This term has a reasonably short history within neuropsychology, having recently largely succeeded the overused and over-inclusive "frontal lobe functions". As such, it may be useful to explore in a little more detail what is subsumed under the term executive functions, and why deficits in these functions may have important consequences, before moving on to explore the relationship between executive dysfunction and SAH.

5. Executive Functioning

Lezak (1995) suggests that behaviour can be thought to belong to 3 functional systems

(1) cognition i.e. information processing

(2) emotionality i.e. feelings and motivations

(3) executive functions

Lezak argues that within neuropsychology, cognition has received the bulk of attention although brain damage rarely affects one system exclusively but to some extent involves all three. Regarding executive functions, she defines these as follows "the executive functions consist of those capacities that enable a person to engage successfully in independent, purposive, self-serving behaviour" (page 42) and as such

they involve the ability to plan, make goals, carry out plans and goals efficiently and effectively, monitor ones performance and utilise the feedback, and some but not all aspects of attention. The relationship of attention to cognition and executive functions is a somewhat debatable one and varies to some extent with the model of brain functioning you adopt. For example, Posner (Posner & Petersen 1990, Posner & Dehaene 1992) sub-divides attention into a number of different systems that carry-out different, but related, functions. One such system is the anterior attention system which is dedicated to executive functions and is involved in gathering and controlling different brain regions to perform complex cognitive tasks, such as those involving divided attention where one has to respond to multiple elements within a single task. In addition, Posner et al also suggest that there is a posterior system which is involved in non- executive aspects of attention such as selective attention where the aim is to differentially select the important stimuli and ignore distracting ones.

Severe executive deficits, as Lezak (1995) points out, are often highly apparent presenting as a total lack of motivation, irritability, lack of insight, rigidity, etc. As has been noted by an increasing number of authors, however, (Lezak 1995, Damasio et al 1994, Mattson & Levin 1990) some patients with milder executive deficits show a striking dissociation between their normal test results on standard test batteries and their day to day functioning. It is suggested that this occurs because most assessments are set within a highly structured framework where the tester provides the scaffold for the session. In addition, many standard tests of intelligence concentrate on overlearned information and many standard neuropsychological tests look only at 1 cognitive modality at any one time e.g. verbal memory. Thus, where the examiner imposes structure, it is as though he or she is assuming the executive functions of planning,

organisation, giving initiative, etc. and therefore executive deficits in these areas are not given a chance to become apparent. This can be further compounded by the use of highly structured, overlearned and less complex tests which fail to elicit the sort of cognitive deficits associated with executive dysfunction which include

(1) mental inflexibility

(2) poor behaviour regulation even where the necessary information is available

(3) poor planning, organisation, and problem solving

(4) poor divergent thinking

(5) difficulty maintaining cognitive set where distracters or interference is present

(Mattson and Levin 1990 page 286)

Instead, these difficulties are apt to show up on tasks requiring novel problem solving (e.g. Action Program Test - sub-test of B A D S), planning and organisation (e.g. Rey Complex Figure, Zoo Map Test - B A D S), divergent thinking (e.g. Word Fluency), ability to follow rules and shift mental set (e.g. Modified Wisconsin, Rule Shift Cards Test), utilise feedback and monitor performance (e.g. Wisconsin Card Sort Test), divided attention (e.g.Trails B, Choice reaction time), and maintain set despite interference (e.g. Stroop Test).

Executive deficits are particularly important as their presence has been linked with poor outcome in a number of psychosocial domains including vocational outcome (e.g. Crepeau & Scherzer 1989), emotional and behavioural changes, and poor social relations (Damasio et al 1994). When one considers the nature of executive deficits i.e. lack of initiative, cognitive inflexibility, difficulty attending to multiple elements at the same time, a lack of self-monitoring and/or use of feedback, etc., one can see why many relatively simple tasks in the social domain become very difficult as they require adeptness in the very areas where the individual is impaired.

5.1 Executive Functioning And SAH

While the majority of the studies reviewed earlier concerning cognitive deficits following SAH did not concentrate on executive dysfunction or frontal lobe functions, the test batteries employed (see Table 1) often included (unwittingly) tests described above as being sensitive to executive deficits, even although they were rarely described as such. For example, Hutter et al (1995) found up to 65% of their sample to be significantly impaired on a choice reaction time task, while Ljunggren et al (1985) report that 19 out of 40 patients showed cognitive dysfunction on the Wisconsin Card Sort Test and 16 out of 40 were impaired on Trails B which requires divided attention. Similarly, Ogden et al 1993 at their 12 months assessment found 44 percent of their sample to be moderately to severely impaired on Trails B, 18 percent showed impaired performance on the Modified Wisconsin Card Sort, 43% were impaired on the copy of the Rey Complex Figure (with 15% showing a piecemeal approach), and 47% impaired on its delayed recall. The authors report the latter result as demonstrating severe and persistent non-verbal memory deficits, but it may equally display poor visuo-spatial

planning and organisation. In an earlier study involving 16 patients who had made good neurological recoveries, Ogden et al (1990) report that 47% of this sample had impaired scores on the copy of the Rey while 94% were impaired on the delayed recall trial. Tidswell et al (1995) using the Wisconsin Card Sort Test and Verbal Fluency report that 51 percent of their sample showed impairment in executive functioning and conclude "the range of affected neuropsychological processes included not only memory but also executive functions sensitive to frontal lobe lesions" (page 880). Additional evidence of executive deficits comes from Shoqeirat et al (1990) who looked at performance on tests sensitive to frontal lobe lesions among 3 groups of amnesiac patients, one of which were subjects who had suffered anterior communicating artery aneurysms. This group where impaired on 2 out of 3 tests of executive functioning (Word Fluency and Cognitive Estimation Test) and their performance on the third (Wisconsin Card Sort Test) just failed to reach significance.

As we have already seen, the relationship between location of aneurysm and nature of cognitive deficits is at best a relatively small one, and even if we look exclusively at patients with good outcomes a range of cognitive deficits still exists. Therefore, it is unlikely that either site of aneurysm or grade of outcome can fully account for the level of executive deficits reported in these studies. It seems clear that a significant proportion of SAH patients, even those making a good recovery, will not only show cognitive deficits but also executive difficulties. What if any are the consequences of this?

1. A significant percentage of SAH patients who are being rated as making "good recoveries" in fact have cognitive and executive deficits which may benefit from rehabilitation.

2. Even assuming an increased awareness of executive deficits in this population, they are unlikely to be identified given the current follow-up arrangements, where patients are seen briefly as out patients to discuss their progress usually with the operating neurosurgeon, but without specialised screening tests being given.

3. Lezak (1987) believes impaired executive functions to be one of "the major neuropsychological limitations to a patient's ability to profit from rehabilitation training" (page 43). As such, it is essential for us to assess who has these difficulties and to what extent when planning rehabilitation as the presence of marked executive deficits will have a significant impact on the choice of rehabilitation methods and the rehabilitation goals set.

4. Cognitive and executive deficits in themselves may be sources of frustration and concern to patients and as such they may benefit from advice and remediation. More importantly, however, cognitive deficits and especially executive deficits have been linked to functional measures of outcome such as return to work and quality of life in subjects with traumatic brain injuries. Brooks et al (1987), for example, found in a sample of 98 head injured patients that verbal memory and attention processes were important predictors of return to work. Wehman et al (1993) examined 39 traumatic brain injury subjects involved in supported employment and compared those 'least difficult' and 'most difficult' to place. Amongst the significant differences they found

were that the 'most difficult' group were less likely to initiate tasks without prompting, displayed more inappropriate behaviours, repeatedly asked for assistance and direction, were less able to recall verbal information, and were less likely to observe the safety requirements of the position. It would appear that the 'most difficult' subjects had a range of executive and cognitive deficits. In addition, Crepeau & Scherzer (1993) in a meta-analysis of predictors of vocational outcome following traumatic brain injury, found executive deficits to be significant predictors of poor vocational outcome. Thus, it may be the case, in SAH that not only do executive deficits contribute to cognitive deficits but that they are important contributors towards impaired psychosocial outcome and reduced quality of life in general.

If we go right back to the start of this chapter, I stated that some SAH patients despite 'good recoveries' did not make as good a functional outcome as we would expect or hope showing difficulties in their everyday lives and reduced quality of life. It may be that we are now in a position to at least in part explain this phenomena. It would appear that a significant number of patients who make 'good recoveries' and show no neurological deficits, irrespective of the site of their aneurysm but perhaps in part due to complications, have experienced a degree of diffuse brain damage. The result is a sequlae reminiscent to that found after closed head injury, that is, they experience a range of cognitive and executive deficits with the latter, in particular, being associated with poor functional outcome such as a reduced quality of life. Before examining any relationship between cognitive and executive deficits and psychosocial outcome including quality of life post SAH I would like to, in a little more detail, examine the literature concerning the impact of SAH on everyday functioning and quality of life.

6. SAH, Everyday Functioning, and Quality Of Life

Over the past 20 or so years there has been an increasing interest in the impact of illnesses and diseases beyond measures of mortality and morbidity to include finer grained analyses concerning activities of daily living (e.g. A D L Scales), perceived health (e.g. Nottingham Health Profile), and functional status (e.g. M O S-S F 36). Whether or not these measures tap quality of life as such is a matter of debate with Joyce (1987) finding that of the first 50 quality of life scales published between 1966 and 1985, 84% measured clinical disability (i.e. mental and somatic disorders) or social adjustment, rather than subjectively perceived well being in relation to health.

AUTHOR	PATIENT GROUP	ASSESSMENTS USED	REPORTED FINDINGS			
Hutter et al 1995	58 aneurysmal SAH patients rated as GOS=1(83%) or GOS=2(17%). Assessed 1-5 years post surgery.	Self-rating scale and BDI (German language version)	Decreased Motivation			50%
			Reduced Mental Capacity			47%
			Reduced Free-Time Activities			52%
			Impaired Social Relations			39%
			Reduced Concentration			70%
			Poorer Sleep			47%
			Headaches			30%
			Decreased Life Satisfaction			37%
			Increased Emotional Lability			41%
Vilkki et al 1990	83 aneurysm patients assessed 1 year post surgery. 42% no infarct on late CT, 52% infarct.	Semi-structured interview covering GOS, work status, social relations, subjective or clinical mental status, and emotional status. Patients classified as either 'normal' or 'impaired' on each category.		No Infarct	Infarct	Total
			Impaired GOS	14%	48%	34%
			Impaired Work Status	8%	38%	25%
			Impaired Social Relations	14%	33%	25%
			Impaired Subjective Mental	40%	69%	57%
			Status	6%	42%	27%
			Impaired Emotional Status			
McKenna et al 1989	83 aneurysm patients assessed 1 year post surgery. 70(84%) without neurological deficit & 13(16%) with.	Semi-structured interview with relative and where necessary patient covering employment, social life, home life, emotional changes, and energy levels.		No Neurological Deficit	Neurological Deficit	Total
			Retired Early Or Stopped Work	24%	69%	31%
			Reduced Work Capacity	7%	23%	10%
			Social Life Affected	4%	23%	7%
			Domestic Tension	14%	8%	13%
			Adverse Emotional Changes	33%	3%	33%
			Reduced Energy Levels	19%	8%	17%
			Any Of The Above	80%	-	-
Ljunggren et al 1985	40 aneurysmal SAH patients assessed an average of 3.5 years post surgery. Rated as having made a 'good neurological recovery'.	Self-report questionnaire and semi-structured interview with subjects.		Self-Report	Clinical Interview	
			Lack Of Initiative, Fatigue, Exhaustion	30%	70%	
			Emotional Changes	8%	75%	
			Memory Dysfunction	18%	58%	
			Reduced Concentration	22%	32%	
			Headaches	30%	25%	
			Reduced Libido	8%	20%	

TABLE4: SAH AND PSYCHOSOCIAL OUTCOME; THE RESULTS OF 4 STUDIES.

In Table 4 above are summarised the main findings of those studies that have examined aspects of quality of life and psychosocial changes following SAH. These studies on the whole do not examine quality of life per se (with the exception perhaps of Hutter et al (1995) who looked at general life satisfaction) but rather tend to concentrate on 5 broad areas:

(1) the presence of cognitive (e.g. concentration) and physical (e.g. headaches) difficulties.

(2) vocational outcome.

(3) impaired social relations and leisure activities.

(4) emotional changes.

(5) impaired energy and motivation.

Direct comparisons of these studies is difficult due to the slightly different populations studied and methods used, i.e. self- report questionnaires or semi- structured interviews, and whether information was gained from the patient or relatives. In broad terms, however, the studies appear to show that cognitive difficulties are commonly reported, with 47% of Hutter et al's (1995) sample reporting reduced mental capacity and 40% of Vilkki et al's (1990) sample, who had no infarct on late C T also reporting impaired subjective mental status. The Hutter et al (1995) and Ljunggren et al (1985)studies would suggest that physical complaints such as headaches, poor sleep,

and reduced libido may also be fairly common, but less so than cognitive difficulties. The study by Hutter et al (1995) found some aspect of social relations to be impaired in up to 52 percent of subjects, while this figure was somewhat less in the studies by Vilkki et al (1990) and McKenna et al (1989) (25% and 13% respectively) and is further reduced when we consider only those with no neurological deficit or no infarct on late C T (both studies then found about 14% of those groups to be impaired on some aspect of social relations).

Two studies examined vocational outcome and reported this was adversely affected in 25 to 41% of their subject groups as a whole, but again, when we only examine those patients within no neurological indicators this figure drops to between 8 to 31%. Three out of the four studies report on adverse emotional changes which range from 27 to 41% of their samples with McKenna (1989) reporting little difference between those who did and didn't have neurological deficits, whereas Vilkki et al (1990) found that 6% of their sample, who had no infarct, showed impaired emotional status compared to 42% of their sample who did have infarct on late C T. Finally, 3 out of four of the studies report on motivation and energy with rather disparate findings. Ljunggren et al (1985), for example, report that 70% of their sample, at interview, reported problems with lack of initiative, fatigue, etc. while McKenna et al (1989), interviewing mainly the relative reports only 17% with reduced energy levels. Hutter et al (1995) using a self- report questionnaire lies somewhere in the middle with 50% reporting decreased motivation. With the available information it is difficult to explain the differences in these findings, although how exactly researchers asked about motivation and energy may have had some impact.

Overall, the studies suggest that a significant percentage of aneurysms patients, regardless of whether or not they have made a good recovery experience subjective cognitive deficits with a slightly smaller percentage also experiencing physical problems. Problems with social relations also appear to be fairly common, although less so when only patients who have made good neurological recoveries are considered. A similar picture is revealed when we look at vocational outcome, although McKenna et al (1989) still report that 31% of their sample who had no neurological deficits 'retired early, stopped work, or had reduced work capacity'. A significant proportion of patients show adverse emotional changes, although one study suggests these may be less prevalent in patients with good neurological recoveries. Lastly, whether or not a significant percentage of SAH patients have problems with motivation and energy remains unclear with the studies finding conflicting results. The results in Table 4 would appear to show that for at least some aspects of psychosocial outcome and presumably quality of life, whether or not you make a good recovery makes a substantial difference. This is confirmed by Vilkki et al who found that patients with neurological deficits were significantly more likely to be classified as impaired in G O S, work status, social relations, and subjective mental status, but not emotional status.

These studies also raise a number of methodological questions. Firstly, the Ljunggren et al study would appear to clearly show that self- report questionnaires underestimate changes in psychosocial functioning and quality of life in comparison to a clinical interview. In addition, the McKenna et al study tends to report the lowest incidence of deficits and was the only study to rely mostly on relatives' reports. This may lead us to assume that relatives report less difficulties than patients. Research in traumatic brain

injury, however, would suggest the opposite to be true with head injured patients under reporting particularly behavioural and emotional changes compared to their relatives (Fleming et al 1996, Brooks et al 1987). For example, McKinlay and Brooks (1984) report high agreement for physical impairments (e.g. 85% agreement for hearing), somewhat less agreement for cognitive problems (e.g. memory 65%), and still less agreement for emotional changes (e.g. 52% agreement as to whether or not the patient had become more anxious). Similarly, Hutter and Gilsbach (1995) call into question the ability of SAH patients to accurately report impairment, finding only a small association between self- ratings and actual impairment ($r=0.32$) while ratings by significant others showed a far greater correlation ($r=0.63$). Tidswell et al (1995), however, failed to find any significant differences when comparing symptom profiles completed by patients and relatives. Thus, the accuracy of SAH patients self- reports remain a rather open question.

6.1 Relation between Psychosocial Outcome, Quality of life and Acute Factors

As we saw earlier, a number of researchers have examined the relationship between cognitive outcome and a number of acute factors such as initial severity of bleed, and pre and post operative complications, with mixed results. Far less interest, however, has been expressed in the relationship between these factors and psychosocial outcome. While in very broad terms it is clear that overall quality of life is affected by acute factors few researchers have looked at this area in any detail. Tidswell et al (1995) found that post operative events causing focal neurological signs, whether permanent or transient, were significantly correlated with relatives' but not patients'

symptom checklists. This 23 item checklist covered a number of areas including vocational outcome, emotional and behavioural changes, and cognitive and physical difficulties. It is possible that psychosocial outcome and quality of life is more sensitive to acute factors and complications than cognitive outcome where, regarding the impact of acute events, the results are inconclusive, although to date no-one has examined this issue in sufficient detail.

6.2 Relationship Between Psychosocial Outcome, Quality Of Life, And Site Of Lesions

As we have seen, few authors have successfully found a significant relationship between aneurysm site and cognitive deficits. Has there been any greater success for psychosocial deficits? Again the research is sparse although Vilkki et al (1990) using the same population as in her earlier study (Vilkki et al 1989) did find some significant relationships between not site of aneurysm per se but data from late C T scans and some aspects of psychosocial outcome. That is patients with left lateral infarct, frontal medial infarct, and those with diffuse damage, generally ,received more classification of 'impaired' on their outcome variables listed in Table 4. In particular, left lateral infarcts were associated with a greater likelihood to be classified as impaired on G O S, and work status; frontal medial with work status and social relations; and diffuse damage associated with impaired G O S and work status. In addition, they report that patients with right lateral infarcts were more likely to be classified as suffering from depression and anxiety. Hutter and Gilsbach (1995) report somewhat conflicting results finding that SAH patients with frontal or right parietal lesions reported less depression and a trend towards reporting less impairment on self- ratings.

6.3 Executive And Cognitive Deficits, Psychosocial Outcome, And Quality Of Life: Is There A Relationship?

It would seem clear that many people following a SAH have difficulties with some aspects of psychosocial outcome and consequently a reduced quality of life. These problems are more marked in individuals who have neurological deficits and perhaps following SAHs involving particular areas of the brain. Nevertheless, they are still apparent in some individuals who achieve a 'good outcome'. Do these psychosocial difficulties stem at least in part from the presence of cognitive and executive deficits as the traumatic brain injury literature would suggest, or should we accept the position put forward by McKenna et al (1989) that there is "no evidence to support the growing claim that SAH produces permanent changes in brain function that undermine the cognitive and emotional life of the victim" (page 367). As already discussed the first part of this proposition would appear to be incorrect with many SAH patients showing deficits in cognitive and executive functioning. The relationship, however, between these deficits and impoverished psychosocial functioning and reduced quality of life is less clear having received little attention in the literature. Vilkki et al (1990) is the only author to address this issue in detail. They examined the relationship between 5 indices of psychosocial outcome (G O S, work status, social relations, subjective mental status, and emotional status) and subjects' performance on a neuropsychological test battery. They found that those classified as impaired on any of the first four above performed significantly worse on the test battery. A stepwise discriminant analysis revealed that those impaired on G O S showed poor verbal memory and cognitive inflexibility; impaired work status was also associated with poor memory and cognitive inflexibility; those with impaired social relations differed in terms of poor memory and planning, and slowed information processing; while an

impaired subjective mental status was found in older patients with poor memory and cognitive inflexibility. On the basis of these results, Vilkki et al (1990)conclude "tests of memory (Free Recall, Object Memory, and Rey figure), cognitive flexibility (Stroop, category identification, and sorting) and verbal efficiency (Stroop I, and fluency- S words), were valid indicators of deficits resulting in poorer outcome... Moreover, the tests of cognitive flexibility, which are known to be sensitive to frontal lobe dysfunction, were better indicators of outcome than the standard intelligence tests" (page 583). One may, perhaps, go further and suggest that these results show that executive deficits in particular are good predictors of poor psychosocial outcome as not only were the tests of cognitive flexibility employed by Vilkki et al (1990) tests known to be sensitive to executive dysfunction but also, some of the tests they ascribed to memory (Rey Figure) and verbal efficiency (Fluency- S words) are also known to be sensitive to executive deficits. Overall 5 out of eight tests they list "as valid indicators of deficits resulting in poor outcome" are in fact sensitive to executive deficits. Therefore this study would appear to show that executive deficits may have an important role in poor psychosocial outcome and consequently quality of life, although this hypothesis remains to be tested directly.

7. Present Study - Aims And Hypothesis

This study aims to examine in more detail than previous studies the incidence of executive deficits among a group of SAH patients who have been rated as making a 'good recovery' on the Glasgow Outcome Scale. The study will examine cognitive deficits, psychosocial functioning, and quality of life post aneurysm and the relationship between these variables and executive deficits. To date, this has received little attention

in the SAH literature, and it is hoped that by examining the relationship between these variables we will be better placed to solve the puzzle as to why some SAH patients despite making a 'good recovery' do not go on to do as well as we would expect or hope. The relationship between these variables and acute factors such as pre and post operative complications, age at onset, and site of aneurysm will also be explored.

By employing a cross-sectional design this study will for the first time allow us to compare relatively early (5 to 22 months) and late outcome (5 or more years) in those making a good recovery from SAH. In addition, by involving both patients and relatives, this study will allow us to compare self- and other reports and comment on the accuracy of self-report measures with SAH patients. It is also the aim of this study to examine the ability of a range of tests (both traditional and more recent) to detect executive deficits in this population.

7.1 Specific Aims and Hypotheses

1. Time Post Aneurysm

Hypothesis 1(A): There will be no significant differences in the two groups (Early - 5-22 months and Late - 5+ years) in terms of cognitive functioning, executive functioning, psychosocial functioning and quality of life.

2. Comparisons with Normative Data and "Clinically Significant" Results

Hypothesis 2(A): Compared to normative data, subjects will show significantly poorer executive functioning, cognitive functioning and quality of life.

Aim 2(A): The study aims to show that a considerable proportion of patients despite making good recoveries will show clinically significant deficits where 'clinically significant' is defined as 2 or more standard deviations below an age corrected normative mean.

3. Executive Functioning

Hypothesis 3(A): There will be a significant positive correlation between executive functioning and psychosocial outcome.

Hypothesis 3(B): There will be an significant positive correlation between executive functioning and quality of life.

4. Acute Factors

Hypothesis 4(A): Older age at onset will be a significant predictor of poorer cognitive functioning, executive functioning, psychosocial outcome and quality of life.

Hypothesis 4(B): Neither pre or post operative complications will be significantly correlated with cognitive or executive deficits.

Hypothesis 4(C): Post operative complications will be significantly correlated with poorer psychosocial outcome and quality of life.

Hypothesis 4(D): There will be no relationship between site of aneurysm and any of the outcome variables.

5. Self vs. Relatives' Reports

Hypothesis 5(A): There will be a tendency for patients to under report deficits, especially behavioural and emotional changes, in comparison with relatives.

6. Exploratory Multiple Regression Analysis

Aim 6(A): the study aims to delineate more clearly than previously the factors that contribute to poor psychosocial functioning and reduced quality of life despite a 'good recovery' from a SAH. Those variables found to be associated with quality of life and psychosocial functioning will be used in exploratory multiple regression analyses to gain a greater understanding of the relationships between these variables.

METHOD

1. Design

A cross sectional design was employed to compare early (5 to 22 months) and late (5+ years) patients post aneurysmal SAH . All patients in the early group were identified through a database held in the neurosurgical unit, Dundee Royal Infirmary and these patients rated on the Glasgow Outcome Scale by a consultant neurosurgeon. The late patients were identified by examining theatre records from 1992 backwards and all patients who had suffered an aneurysmal SAH selected. These patients were then rated on the Glasgow Outcome Scale by a consultant neurosurgeon retrospectively from their notes. Thus, as far as possible, the study attempted to include all consecutive cases of SAH who made a 'good recovery' and fell into the defined time periods.

No control group was employed in this study primarily due to the difficulties inherent in finding a suitable comparison group for SAH patients (see pages 11-13). On the questionnaire measures, however, a close relative was asked to complete alternative forms of the main questionnaires as some doubt has been placed on the accuracy of self- report data in this population.

2. Subjects

The subjects were 36 patients who had suffered an aneurysmal SAH either 5 to 22 months or 5 + years previously who required surgery to clip their ruptured

aneurysm(s). The following inclusion and exclusion criteria were employed in this study.

- 18 - 65 years at time of surgery.
- no previous history of acquired cerebral damage.
- no additional cerebral damage since time of aneurysm.
- neurosurgically a good outcome i.e. GOS=1.
- no significant history of alcohol/substance abuse.
- English as first language.
- no history of major psychiatric illness.
- not currently on large doses of psychotropic medication
- no medico-legal actions pending.

Eighteen subjects belonged to the early group and 18to the late group. These groups were not matched but represent a consecutive sample drawn from each time period.

3. Measures

3(A) Psychometric Assessment

3(Ai) Executive Functioning

1. Behavioural Assessment Of Dysexecutive Syndrome (Wilson et al 1996)

This recently devised test battery was designed to detect executive deficits and the impact these have on everyday functioning. The battery consists of six sub-tests

(detailed below) each of which has a converted score from 0 to 4 which are summed to give a profile scores of 0 to 24. These scores can be converted into an age standardised score with a mean of 100 and standard deviation of 15. The instrument has been shown to differentiate normal controls from a group of brain injured patients of mixed aetiology, with all six sub-tests showing a significant difference between patients and controls. In addition, the authors' report adequate inter rater and test re-test reliability. In terms of validity, the authors' demonstrated moderate correlations between the Behavioural Assessment of Dysexecutive Syndrome and others' ratings of everyday executive problems.

1.1 Rule Shift Cards

Subjects flick through a book of 21 playing cards responding to each card according to a simple rule ("say 'yes' to the red and 'no' to a black"). The rule is then changed ("say' yes' if the card is the same colour as the last one otherwise say 'no'") and the subject asked to go through the cards again following this new rule. Only the second trial is used for scoring where points are awarded for accuracy in following the rule.

1.2 Action Program Test

This task which is adapted from Klosowska (1976) requires novel problem solving to remove a small cork from a long tube using water, a wire, and a small container. Points are awarded for each stage completed independently. Patients with frontal lesions have been shown to perform particularly poorly on this task.

1.3 Key Search Test

The subject is asked to imagine they have lost their keys in a large field represented by a large square on a piece of A 4 paper. They are asked to draw a line to show where they would walk to search the field, such that no matter where in the field their keys are they would make sure they found them. This test looks at the subject's ability to plan an efficient search and monitor their own performance

1.4 Temporal Judgement Test

Subjects are asked to estimate the length of time involved in 4 commonplace events or occurrences e.g. "how long does it take to do a routine dental check-up take?". One point is awarded for each estimate within pre-defined parameters.

1.5 Zoo Map Test

This test requires planning, an ability to follow rules, and the ability to monitor and modify ones performance. In the first part of this test, subjects are presented with a map of a zoo and also on one side a list of places they are to visit, and on the other a number of rules they have to follow. The subject's task is to visit all the places listed with no, or as few errors as possible. In the second low demand trial, the locations and rules are the same, and the order in which to visit the locations is provided. Thus, for a perfect performance in this trial the subject merely has to follow the instructions given without planning ahead. In both parts the subject's score is derived from whether they visit the appropriate places in the correct order without breaking the rules.

1.6 Modified 6 Elements Test

This test which is a shortened and simplified version of the Six Elements Test (Burgess & Shallice 1991) looks at the subject's ability to organise competing tasks in

a limited period of time. That is, subjects are presented with three tasks: describing events, arithmetic problems, and picture naming. Each task is split into two parts A and B. Subjects are told they have 10 minutes to complete as much as they can of these six parts, although they are correctly informed that the time allowed is insufficient to fully complete all six parts. Rather they are requested to complete some of all six parts. In addition, subjects are told that there is one rule they must follow, which is they must not do the two parts (A and B) of the same task one after the other. Points are awarded according to the number of parts attempted and the number of times this rule is broken.

2. Modified Card Sort Test

The Modified Card Sorting Test (Nelson 1976) is a shortened and simplified version of the Wisconsin Card Sorting Task (Grant & Berg1948). The Wisconsin Card Sorting Task consists of 4 stimulus cards which vary on 3 parameters- colour, shape, and number of items. The response cards are 2 sets of 64 cards which constitute all possible variations in colour, shape, and number presented in the stimulus cards. The subject's task is to sort these cards into 4 piles, 1 beneath each stimulus card according to a number of rules (colour, shape, and number) although the subject is not told the rule but merely whether they are 'right' or 'wrong' after they put down each card. Furthermore, after 10 consecutive correct responses the rule is changed. In the Modified Card Sorting Task the 4 stimulus cards remain the same but the number of response cards are reduced to 2 sets of 24 each of which only share a single attribute (colour, number or shape) with 3 out of the four stimulus cards. The subject's task is again to sort the cards, but in this version the first rule they choose is deemed to be

correct and the rule is changed after only six consecutive correct responses. The subject is told that the rule has changed but not what the new rule is.

Nelson (1976) suggests that the Modified Card Sorting Test provides essentially the same result as the Wisconsin Card Sorting Task although others, for example Lezak (1995) have suggested that the Modified Card Sorting Test is less sensitive. Nevertheless, Nelson (1976) reports that the Modified Card Sorting Test successfully differentiated a group of patients with brain injuries from mixed aetiologies from controls, and furthermore, patients with frontal lesions did significantly worse than patients with lesions elsewhere. This tests yields 3 results - 1. number of categories achieved i.e. number of rules correctly followed; 2. number of errors; and 3. percentage of perseverative errors, a perseverative error being where a subject sorts by a rule (e.g. shape) immediately after sorting by that rule and being told the response was incorrect, or having just been told the rule had changed. The Modified Card Sorting Test requires cognitive flexibility and the ability to utilise feedback which are both important executive functions.

3. Verbal Fluency

In this test subjects are asked to produce as many words as they can in a minute belonging to firstly a category ('animals') and then beginning with specific letters (C, F and L). Verbal fluency in general is sensitive to brain dysfunction, particularly mental inflexibility, an aspect of executive dysfunction, with patients with left frontal lesions performing particularly poorly (e.g. Micela et al 1981).

4. Trail Making Test Parts A & B

These tests look at simple and complex visuo-motor skills respectively. In Part A, the subject must join up 25 numbers in order as quickly as they can, while Part B contains both numbers and letters which again must be joined in ascending order but with the added difficulty that subjects must alternate between numbers and letters. Parts A and B are both sensitive to brain dysfunction (Leininger et al 1990) although Part B with its emphasis on divided attention is more likely to expose executive dysfunction.

3(Aii) Memory

1. Logical Memory Immediate And Delayed

Verbal memory sub-test of the WAIS-R (Wechsler 1987). The subject is asked to recall a short verbally presented passage immediately after hearing it and then after a 30 minute delay. Scores are awarded on the basis of accuracy and completeness of recall. Logical memory has been shown to be sensitive to the effects of brain injury with Dikmen et al (1990) finding that it could distinguish head injured patients from controls even two years post injury, and it is also reported as being particularly sensitive to left sided lesions (Chelune & Bornstein 1988).

2. Visual Reproduction Immediate And Delayed

Visual memory sub-test of the WMS-R(Wechsler 1987). The test consists of four items, each of the first three consisting of a single design printed on card and the fourth, two designs printed on the same card. After being shown each item for five seconds the subject is asked to immediately draw what they can remember of the design. After a 30 minute delay they are asked to produce what they can still recall of

the designs. Visual reproduction has been found to be sensitive to the effects of brain injury consistently distinguishing subjects with mild brain injuries from normal controls (Lezak 1995). This test does not appear to be differentially sensitive to right sided lesions as might be expected given its visual nature as many patients verbally encode some of the designs.

3(Aiii) Visuo-spatial Skills

1. Block Design

Sub-test of the WAIS-R (Wechsler 1981). In this visuo-spatial construction task subjects are asked to construct designs using up to nine red and white blocks corresponding to those printed on cards. Designs must be totally accurate and completed within a time limit to gain points. Additional points are awarded for rapid completion. Block Design tends to be sensitive to the presence of any brain injury but patients with right sided lesions involving posterior areas tend to do worse (Lezak 1995).

3(Aiv) Pre-Morbid Intellectual Ability

1. National Adult Reading Test (NART)

Measure of pre-morbid intellectual ability (Nelson 1982). This test comprises 50 words many of which are uncommon and all of which require irregular pronunciation. The subject is merely asked to read each word aloud and the number of words misprounounced recorded. This error score can then be converted to give an I Q score. The National Adult Reading Test has been shown to be a reliable and valid measure of

pre-morbid intellectual ability with Crawford et al (1989), for example, reporting that the NART predicted 66 percent of the variance of WAIS Full Scale I Q. More recently, however, there has been some concern that the National Adult Reading Test is being used rather indiscriminately, and in some patient groups where there is evidence to suggest that it significantly underestimates pre-morbid intellectual ability e.g. Korsakoff's Syndrome (O'Carrol et al 1992).

While the validity of the NART for SAH patients has not been directly examined the evidence reviewed thus far suggests that language difficulties are rare, especially among those making a good recovery and as such it would appear reasonable to assume the NART to be a valid measure of pre-morbid intellectual ability in the present studies' population.

3B. Self- Report Questionnaires

3(Bi) The Dysexecutive Questionnaire (DEX)- Self-Report (Wilson et al 1996)

This is a 20 item questionnaire designed to tap problems often associated with executive deficits (see Appendix 1 for copy of questionnaire). The authors' report that the questionnaire covers four common areas of dysexecutive function: emotional and personality changes, motivational changes, behavioural changes, and cognitive changes. Each item is scored 0 to 4 giving a range of scores from 0 to 80 with the higher the score the more pronounced the executive deficits. Unfortunately, Wilson et al (1996) provide no information on the reliability of this measure nor normative data although they do provide means for their brain-injured sample, rather they see it as being used in a more qualitative manner. The authors' report a significant difference

between this Self- Report version of the D E X and the Independent rater's version, with patients reporting less executive deficits than relatives. In addition, this self-report measure shows no significant correlations with the Behavioural Assessment Of Dysexecutive Syndrome battery while the independent rater's scores are significantly correlated with all the sub-tests and the overall profile scores ($r=-0.62$, $p<0.001$).

3(Bii) WHOQOL-BREF (WHOQOL Group 1996)

This 26 item measure is a brief measure derived from the WHOQOL-100 a 100 item questionnaire developed by the WHOQOL Group within 15 international field centres (See Appendix 1). This longer item consists of four items for each of 24 facets of quality of life and a further four items concerned with overall quality of life and health. Factor analysis has shown that 4 domains account for the majority of the variance in this instrument and as such the WHOQOL-BREF is based on these 4 domains with an additional two questions looking at overall quality of life and health. These are outlined below-

Domain 1: physical health

Domain 2: psychological

Domain 3: social relationships

Domain 4: environment

General 1: "How would you rate your quality of life?"

General 2: "How satisfied and you with your health?"

Each item is scored on a 5 point Likert Scale and domain scores calculated where the higher the domains score, the greater the quality of life. Domain scores can then be transformed to give scores compatible with the WHOQOL-100. It should be emphasised that the WHOQOL-BREF is very much a measure of perceived quality of life and as such it is not a symptom checklist or a health profile but, rather a subjective measure of the effects of diseases, illnesses, and interventions on quality of life.

3(Biii) Questionnaire For SAH Patients

This instrument is derived from McKinlay et al's (1990) Questionnaire For Relatives which is itself based on a 90 item semi-structured interview developed by Brooks and McKinlay (1981). The original semi- structured interview was developed for use with a close relative of traumatically brain injured adults to assess 'objective burden' associated with changes in the patient that had emerged since the injury. One questions also asked the relative to rate their level of 'subjective burden'. Brooks and McKinlay (1981) report adequate inter rater reliability using a pilot version of this questionnaire. Items for the semi- structured interview were derived from the literature and clinical experience and covered 7 broad areas:-

1. Physical e.g. sensory and motor impairments

2. Language e.g. word finding difficulties

3. Emotional e.g. irritability, outbursts of temper

4. Dependence e.g. items dealing with self- care and supervision

5. Subjective e.g. tiredness, slowness

6. Memory e.g. mislays things

7. Behaviour change e.g. less tactful

In addition, a number of questions also pertain to any changes in vocational status, and any changes in the subject's sexual relationship since the bleed. Unfortunately, normative data is unavailable for this questionnaire although Brooks and McKinlay (1981) report that at one year post injury the most common problems reported by relatives are emotional changes, memory problems, and subjective symptoms e.g. slowness, with physical problems being less common, and high levels of dependence less frequent still. Furthermore, Brooks et al (1986) using the same questionnaire report a similar picture at five years post injury reporting no reduction in the problems reported.

The questionnaire for SAH patients is little altered from McKinlay et al's (1990) Questionnaire For Relatives except it is in the first person for the patient /subject themselves to complete and, where appropriate, the word 'aneurysm' has been substituted for 'injury' (Appendix 1). Overall the current measure consist of 65 items

from which 7 scores corresponding to the above categories can be derived and these are transformed to give a scaled score from 0 to 10 for ease of comparison.

3(Biv) Hospital Anxiety And Depression Scale (HADS)

The HADS (Zigmond & Snaith 1983) is a 14 point scale designed to provide a brief measure of anxiety and depression (seven items relating to each). It is intended for use with medical out patients and avoids the more physical symptoms of depression and anxiety as these may artificially inflate the scores of medical out patients. Zigmond & Snaith (1983) report a high level of internal consistency and reasonable validity when compared with psychiatric ratings of 100 medical out patients ($r=0.54$ for anxiety and $r=0.79$ for depression).

Each item is scored 0 to 3 yielding a score of 0 to 21 for both depression and anxiety with the higher the score, the greater the depression or anxiety with the following cut offs reported:-

0 to 7= 'normal'

8 to 10= 'mild'

11 to 14= 'moderate'

15 to 21= 'severe'

3C. Relatives' Questionnaires

3(Ci) Dysexecutive Questionnaire (D E X) Independent Rater (Wilson et al 1996)

This 20 item questionnaire is equivalent to the self- report measure (see page 56) except it is completed by a close relative aware of the individuals current functioning

(Appendix 2). Wilson et al (1996) suggest this measure to be a more accurate reflection of executive difficulties compared to the self- report measure as it shows significant correlations with the BADS test battery.

3(Cii) WHOQOL-BREF Relatives' Version

As discussed elsewhere, there is some evidence to suggest a significant degree of discrepancy between subjects' and relatives' report in the present population. To investigate this the WHOQOL-BREF questionnaire has been modified, retaining the same questions and domains, but the wording changed for a relative to complete with reference to the subject (Appendix 2).

3(Ciii) Questionnaire For Relatives

This questionnaire was adapted from McKinlay et al's (1990) 'Questionnaire For Relatives' intended for use with relatives of traumatically brain injured patients. It has been little altered in doing so with the 7 domains discussed earlier when its equivalent patients' version (Questionnaire for SAH Patients, page 58) was briefly outlined still being present. These are transformed to give scaled scores from 0 to 10 (Appendix 2).

3D Neurological And Acute Data

3(Di) G O S Rating

All Dundee Royal Infirmary (DRI) patients who had had an aneurysmal SAH within the defined time periods were identified and rated retrospectively by an experienced consultant neurosurgeon on the Glasgow Outcome Scale (Jennet & Bond 1975) where-

1='good recovery'

2='moderate disability'

3='severe disability'

More details on these categories are given in Appendix 3. Following an aneurysmal SAH patients are routinely followed up as out patients by their consultants, with an appointment some 3 months post discharge being standard practice. The notes and letter from this 3 month follow up formed the basis for the G O S rating.

3(Dii) Acute Data

The following data was gathered retrospectively from patients' notes from the time of the aneurysm-

1. Location of aneurysm

2. Evidence of and where specified type of pre or post operative complications.

4. Procedure

The G Ps of patients who had been identified as suitable candidates to take part in the study were approached by letter (Appendix 4) to inform them about the study and seek

any reasons why they considered individual patients shouldn't be approached to take part. If no objections from the GP were received potential subjects were sent an introductory letter and information sheet (Appendix 4), and this was followed up by a telephone call 2 to 3 days later in order to answer any queries regarding the study and arrange an appointment for the assessment, if the individual was agreeable. The assessment took place either at Dundee Royal Infirmary or the subject's home depending on their preference, and lasted approximately one and a half to two and a half hours. Prior to the assessment beginning, the study was again explained, any questions answered, and the opportunity given for subjects to withdraw without it compromising their future medical care. The confidential nature of all the information gathered was reiterated.

Where possible, subjects and relatives were asked to complete the questionnaires during the assessment session although this wasn't always possible due to time constraints and / or lack of an appropriate relative. In such circumstances, subjects were provided with the questionnaires and a stamped addressed envelope and asked to return them. Following completion of the assessment, subjects were given brief feedback regarding their performance and any concerns the assessment had highlighted discussed. Subjects were offered a copy of a brief summary of the study's findings once complete.

RESULTS

1. Subjects

1.1 Early Group

Thirty-nine patients (32 women and 7 men) were identified whom had been operated on for an aneurysmal S A H and were 5 to 22 months post aneurysm during the data collection phase of this study. Two patient were immediately excluded due to being over the age of 65 at the time of their operation. Of the remaining 37 patients 23 were rated as having made a good recovery (GOS=1) at 3 months post bleed. Closer examination of patient files revealed that 2 of these patients contravened the studies inclusion criteria and a further 2 patients couldn't be traced leaving 19 potential subjects. The G P's of these patients were approached and one replied to inform us that unfortunately that individual had recently died. The remaining 18 patients were approached to take part in the study and all agreed.

This group consisted almost entirely of women (16 out of 18) and the average age at the time of assessment was 51.1 years (range 36.5 - 64.5 years) with subjects on average being seen 12.6 months after their operation. Full neuropsychological data was gathered for all 18 subjects but only 16 sets of full patient and relatives' questionnaires were available for analysis.

1.2 Late Group

Sixty-seven patients (52 women and 15 men) who had suffered an aneurysmal S A H and where treated in the DR I between July 1989 and December 1992 were identified. Eleven patients were immediately excluded as being over the age of 65 at the time of their operation leaving 56 potential subjects. Of these, no records could be obtained for 4 patients, 1 was deceased, and 4 contravened the study's inclusion criteria, leaving 46 potential subjects. From these 46 patients, 26 patients were identified as having made a good recovery (G O S=1). Seven of these patients could no longer be contacted leaving 19 patients who were successfully approached concerning the study. All 19 initially consented to take part although one subject subsequently dropped out. Neuropsychological data was gathered for all 18 subjects but 2 subjects failed to return questionnaires resulting in 16 full sets of patients' and relatives' questionnaires being available for analysis.

This group consisted almost entirely of women (17 out of 18) and the mean age at time of assessment was 52.8years (range 34.1 - 64.2 years). The mean age at the time of the aneurysm was 46.8 years (range 26.8 - 59.8 years) and they were seen an average of 72.2 months (s.d. 14.2) after their aneurysm.

2. Time Post Aneurysm

2.1 Hypothesis 1 (A): There Will Be No Significant Differences In The Two Groups In Terms Of Executive Functioning, Cognitive Functioning, Psychosocial Functioning, And Quality Of Life.

Prior to describing the performance of these groups on the neuropsychological assessment and questionnaires any differences between the early and late groups on the study variables will be examined. If, as hypothesized, there are no significant

differences between the two groups in terms of cognitive functioning, executive functioning, psychosocial functioning, and quality of life, then they can be considered as a single group for subsequent descriptions and analysis.

The mean and standard deviations for the early and late groups for the neuropsychological assessment and questionnaires are shown in Table 5 below.

TEST/QUSTIONNAIRE	EARLY MEAN (SD)	LATE MEAN (SD)
EXECUTIVE FUNCTIONING		
BADS-Key Search	1.8 (1.4)	1.90 (1.1)
BADS-Zoo Map Test	1.9 (0.8)	2.1 (0.8)
BADS-Temporal Judgement	2.3 (0.7)	2.7 (0.8)
BADS-6 Element Test	2.4 (1.3)	2.8 (1.3)
BADS-Card Sort Test	3.1 (0.8)	2.9 (1.2)
BADS-Action Program Test	3.7 (0.8)	3.2 (0.9)
BADS-Age Scaled Score	83.8 (18.4)	85.2 (18.8)
MCST-Categories	4.3 (1.5)	4.4 (1.8)
MCST-Total Errors	11.9 (7.5)	13.6 (10.3)
MCST-% of Perseverative Errors	20.8 (11.8)	20.1 (20.7)
Trails B-Percentile	58.6 (27.3)	54.2 (26.2)
Verbal Fluency (CFL)-Transformed Score	37.1 (12.4)	44.9 (11.6)
COGNITIVE FUNCTIONING		
Block Design- Age Scaled Score	9.6 (2.9)	10.1 (2.8)
Verbal Memory-Immediate Recall(%ile)	33.9 (28.5)	29.8 (25.7)
Verbal Memory-Delayed Recall(%ile)	34.1 (24.8)	35.3 (23.6)
Visual Memory-Immediate Recall(%ile)	39.8 (30.4)	44.8 (11.6)
Visual Memory-Delayed Recall(%ile)	41.8 (31.0)	40.2 (30.2)
Verbal Fluency -Animals	17.3 (3.9)	16.5 (4.8)
Trails A-Percentile	47.5 (29.8)	57.2 (24.81)
QUALITY OF LIFE-PATIENTS REPORTS		
QOL-Physical Health	17.1 (1.9)	15.9 (3.3)
QOL-Psychological	15.9 (1.8)	14.8 (3.4)
QOL-Social Relationships	17.0 (2.4)	16.8 (3.0)
QOL-Environment	16.9 (1.7)	16.1 (2.6)
QUALITY OF LIFE-RELATIVES REPORT		
QOL-Physical Health	16.3 (3.1)	15.9 (3.3)
QOL-Psychological	16.4 (2.0)	15.4 (3.3)
QOL-Social Relationships	16.5 (3.3)	!6.1 (3.0)
QOL-Environment	16.3 (3.3)	15.8 (2.6)
PSYCHOSOCIAL FUNCTIONING-PTS		
Physical		
Language	0.83 (1.4)	1.4 (1.6)
Emotional	1.6 (1.5)	2.3 (2.2)
Dependence	0.2 (0.7)	0.3 (0.8)
Subjective	2.8 (2.1)	3.2 (2.2)
Memory	1.8 (1.7)	3.1 (1.8)
Behaviour Change	1.3 (1.3)	1.6 (2.3)
PSYCHOSOCIAL FUNCTIONING-RELS		
Physical	0.7 (1.1)	1.4 (1.5)
Language	0.8 (1.5)	0.7 (1.2)
Emotional	2.4 (2.4)	2.5 (2.2)
Dependence	0.4 (1.1)	0.3 (0.7)
Subjective	2.9 (2.2)	3.1 (2.5)
Memory	2.8 (3.1)	3.6 (2.6)
Behaviour Change	1.6 (2.0)	1.6 (2.0)

TABLE 5: MEAN SCORES AND STANDARD DEVIATIONS FOR EARLY AND LATE GROUPS

Rather than perform a large number of t tests to investigate any differences between the means of these two groups which would be prone to Type I errors, a smaller number of multivariate analyses were performed to look at any differences between the groups and highlight any trends within the data. The study variables were divided into those dealing with executive functioning, cognitive functioning, patients' rated quality of life, patients' rated psychosocial functioning, relatives' ratings of quality of life, and relatives' ratings of psychosocial functioning. For each analysis, time post bleed (early or late) was included as a factor while the relevant study variables were entered as independent variables.

The variables entered in each multivariate analysis and the results are given in Table 6 below.

VARIABLE GROUPING	VARIABLES IN ANALYSIS	EXACT F (DF)	SIGN. OF F
EXECUTIVE FUNCTIONING	MCST-Cats, MCST-Errs, MCST-%Pcr, BADS-ASS, BADS6, BADSA, BADSC, BADSK, BADST, BADSZ, TrailsB-%ile, VFL-Trans	2.2 (12,23)	0.06
COGNITIVE FUNCTIONING	BD-ASS, VEMEMI-%ile, VEMEMD-%ile, TrailsA-%ile, VISMEMI-%ile, VISMEMD-%ile, Animals	1.1 (7,28)	0.39
QOL-PATIENTS RATING	QOL1, QOL2, QOL3, QOL4	2.1(6,25)	0.10
PSYCHOSOCIAL FUNCTIONING-PTS	Physical, Language, Emotional, Dependence, Subjective, Memory, Beh. Change	1.2 (7,24)	0.33
QOL-RELATIVES RATING	RQOL1, RQOL2, RQOL3, RQOL4	1.3 (6,25)	0.31
PSYCHOSOCIAL FUNCTIONING-REL	RPhysical, RLanguage, REmotional, RDependence, RSubjective, RMemory, RBeh. Change	0.8 (7,24)	0.62

TABLE 6: MULTIVARIATE ANALYSES COMPARING EARLY AND LATE GROUPS ON EXECUTIVE FUNCTIONING, PATIENTS' AND RELATIVES' QUALITY OF LIFE, AND PATIENTS 'AND RELATIVES' PSYCHOSOCIAL FUNCTIONING

It can be seen that none of the multivariate tests were significant given, a significance level of 0.05, although the multivariate test for executive functioning neared significance. Looking more closely at the univariate F tests for each of the variables in

this analysis none of these meet the more stringent 0.01 level of significance adopted due to the large number of variables, although BADS- Action program Test (F=4.3 (1,34), p=0.05) and Verbal Fluency - Transformed Total Score (F=3.8 (1,34), p=0.06) came the closest. Overall, the results suggest a slight trend for the late group to do better on t91,34he tests of executive functioning with 8 out of 12 scores being superior.

In addition, independent t tests were used to compare the groups ratings on DEX self-ratings (t=0.65 (30), p=0.52) and DEX relatives' ratings (t=0.22 (30), p=0.83) their NART full scale I Q(t=1.08 (34), p=0.29), their age at the time of the bleed (t=1.17 (34), p=0.25), their age at the time of assessment(t=0.60 (34).p=0.25), and their HADS depression(t=0.83 (30), p=0.42) and HADS anxiety scores(t=0.58 (30), p=0.56). None of these analyses displayed a significant difference between the early and late groups.

In conclusion, Hypothesis 1 A has been supported in that there is no demonstrable significant difference between the early and late groups in terms of executive functioning, cognitive functioning, quality of life, and psychosocial functioning. Given that no significant differences between the groups are apparent, I propose to combine the groups in future descriptions and analyses.

3. Comparisons with Normative Data and "Clinically Significant" Deficits

3.1 Hypothesis 2 A: Compared To Normative Data Subjects Will Show Significantly Poorer Executive Functioning, Cognitive Functioning, And Quality Of Life.

Presented in Table 7 below is data for the group as a whole and where available the comparative normative data. Study data and normative data were compared for individual variables using one sample t tests and a significant level of 0.01 adopted. The results of these tests are displayed in Table 7.

TEST / SUB-SCALE	MEAN (SD)	CONTROL MEAN	REF.	1-SAMPLE t	SIGN.
EXECUTIVE FUNC.				DF=35	
BADS-6 Elements	2.6 (1.3)	3.5		4.27	<0.001
BADS- Action Program	3.4 (0.8)	3.8		2.32	0.027
BADS- Cards	3.0 (1.0)	3.6	Wilson	3.11	0.004
BADS- Key Search	1.9 (1.2)	2.6	et al	3.56	0.001
BADS- Temporal	2.5 (0.7)	2.2	1996	2.85	0.007
BADS- Zoo Map	1.8 (0.8)	2.4		3.63	0.001
BADS-ASS	84.5 (18.4)	100		5.07	<0.001
MCST- Categories	4.4 (1.6)	5.0	Nelson	2.36	0.024
MCST- Errors	12.8 (8.9)	9.2	1976	2.40	0.022
MCST- %Per.	20.4 (16.6)	23.0		0.93	0.360
Trails B	98.6 (58.8)	93.8	Lezak '95	0.49	0.629
Verbal Fluency	41.0 (37.5)	37.5	Lezak '95	1.68	0.101
COGNITIVE FUNC				DF=35	
Block Design- ASS	9.8 (2.8)	10.0	Wechsler '81	0.36	0.72
Verbal Memory-I R	18.7 (6.7)	23.7		4.49	<0.001
Verbal Memory-D R	14.9 (6.2)	19.4	Wechsler	4.39	<0.001
Visual Memory-I R	27.9 (6.7)	30.2	1987	2.07	0.046
Visual Memory-DR	24.2 (8.8)	26.3		1.81	0.079
Verbal Fluency -Animals	16.9 (4.3)	22.1	Goodglass '72	7.19	<0.001
Trails A	40.3 (15.2)	38.1	Lezak '95	0.86	0.397
QUALITY OF LIFE- PATIENTS REPORTS				DF=31	
QOL-Physical Health	16.5 (2.7)	17.2		1.48	0.15
QOL-Psychological	15.3 (2.8)	14.9	WHOQOL	1.00	0.34
QOL-Social Relationships	16.9 (2.7)	15.8	Group	2.29	0.03
QOL-Environment	16.5 (2.2)	15.0	1996	3.79	0.001
QUALITY OF LIFE- RELATIVES REPORT				DF=31	
QOL-Physical Health	16.1 (3.4)	17.2		1.87	0.07
QOL-Psychological	15.8 (2.7)	14.9	WHOQOL	1.96	0.06
QOL-Social Relationships	16.2 (3.1)	15.8	Group	0.75	0.46
QOL-Environment	16.0 (2.9)	15.0	1996	1.96	0.06

TABLE 7: MEANS AND STANDARD DEVIATIONS FOR WHOLE SAMPLE AND COMPARISONS WITH NORMATIVE DATA USING 1-SAMPLE t TESTS

These results show that the sample scored significantly less than would be expected from normative data on the majority of the BADS sub-tests and on the overall age scaled score. On the Modified Card Sort Test subjects tended to gain less categories and make more errors than would be expected from normative data, although this failed to reach significance. On Verbal Fluency and Trails B there was no significant difference from normative data.

Turning to more general cognitive functioning, the group showed significantly reduced immediate and delayed verbal memory and there was some trend for visual memory to be impaired but this failed to reach significance. Visuo-spatial skills (Block Design) and general speed of information processing (Trails A) did not differ from normative data. Pre morbid intellectual ability assessed using the National Adult Reading Test demonstrated that all subjects had an estimated pre-morbid Full Scale IQ in the average range or above (mean=104.1, sd=7.4).

It was also hypothesized that subjects would show a reduced quality of life compared to normative data but when we compare either patients' own reports or relatives' reports we find little evidence of this. In fact, patients' ratings of their environment (domain 4) are significantly above those reported in normative data and they also show a trend towards higher scores on social relationships (domain 3).
These results suggest mixed fortunes for Hypothesis 2 A. There is evidence to support the idea that some executive and general cognitive functions are impaired in comparison to normative data, but absolutely no evidence to suggest that these subjects have an impaired quality of life as measured by the WHOQOL-BREF.

3.2 Aim 2(A): "Clinically Significant" Deficits

As discussed earlier (page 11), looking at group means can often disguise clinically significant deficits that are revealed when we examine individual patient profiles. It has been the trend amongst studies looking at outcome post aneurysmal S A H to examine individual results for clinically significant cognitive deficits where "clinically significant" is generally taken to indicate two or more standard deviations below an age corrected mean, or below a pre set cut-off. This also corresponds with Lezak (1995, page 159) who suggests 1.3 standard deviations - 2 standard deviations below the mean to be "borderline" and 2+ standard deviations to be "impaired". Table 8 shows the percentage of patients falling within each of these categories for the main study variables with the exception of Trails A and B where scores at or below the 10th percentile are included, and Verbal Fluency and HADS anxiety & depression where pre determined cut-offs are applied.

It can be seen from Table 8 below that the level of clinically significant deficits ranges from some 3 to 33% of the sample depending on the neuropsychological test examined. Some 10 to 19% of subjects tended to show clinically significant deficits on tests of executive functioning as opposed to only 3% on visual spatial functioning (block design) and 8% on visual motor information processing (Trails A). Memory problems were apparent in some 3 to14 % of the sample with deficits in visual memory being the more common. If scores in the borderline range are also considered then these percentages are increased considerably with up to 36% of the sample demonstrating at least mild executive deficits and a similar percentage showing some form of mild memory deficits.

TEST/SUB-SCALE	'BORDERLINE' (>1.3sd) PERCENTAGE	'IMPAIRED' (>2sd) PERCENTAGE
EXECUTIVE FUNCTIONING		
BADS-ASS	36.1	13.9
MCST- Categories	30.6	19.4
MCST- Errors	27.8	11.2
MCST- %Per.	2.8	2.8
Trails B	8.3% < 10th%ile	-
Verbal Fluency	16.7%	11.1
COGNITIVE FUNCTIONING		
Block Design- ASS	11.1	2.8
Verbal Memory-I R	36.1	5.6
Verbal Memory-D R	22.2	2.8
Visual Memory-I R	25.0	13.9
Visual Memory-DR	16.7	8.3
Verbal Fluency -Animals	61.1	33.3
Trails A	8.3% < 10th %ile	-
QUALITY OF LIFE-PATIENTS REPORTS		
	28.1	18.8
QOL-Physical Health	12.5	9.4
QOL-Psychological	9.4	3.1
QOL-Social Relationships	6.3	6.3
QOL-Environment		
QUALITY OF LIFE-RELATIVES REPORT		
QOL-Physical Health	40.6	31.3
QOL-Psychological	3.1	3.1
QOL-Social Relationships	15.6	3.1
QOL-Environment	6.3	6.3
ANXIETY AND DEPRESSION		
HADS-Anxiety	'moderate' or worse 22.6%	'severe' 6.4%
HADS-Depression	'moderate' or worse 6.4%	'severe' 6.4%

TABLE 8: PERCENTAGES OF PATIENTS SHOWING BORDERLINE AND IMPAIRED PERFORMANCES IN COMPARISON TO NORMATIVE DATA

When quality of life is considered, some 3 to 19% of patients report levels of quality of life more than 2 standard deviations below the mean with the highest percentage being reported for physical health, a similar picture is provided by relatives' reports but here some 31% report that the subjects' physical health is 2 or more standard

deviations below the mean. Looking at scores from the HADS Scale, these show that over 20% of the sample is suffering from moderate or severe anxiety and some 6% have moderate or severe depression.

We can also examine clinically significant deficits by subject rather than test. When this is done for the 12 main results from the neuropsychological assessment, it is found that 14 subjects (38.9%) had no deficits and 13 (36.1%) had only one clinically significant deficit, a number of which may have been due to chance given this number of tests. Three subjects (8.3%) had 2 scores more than 2 standard deviations below the mean and a further 6 subjects (16.7%) had 4 of more scores 2 standard deviations below the mean, suggesting some 25% of subjects had clinically significant neuropsychological deficits. When scores in the borderline range are also included we find 15 subjects (41.7%) with 0 to 1 scores in the borderline or impaired range and 9 subjects(25%) with 2 to 3 scores in the borderline to impaired range. Twelve subjects (33.3%) had scores in the borderline or impaired range in 4 or more of these 12 tests of neuropsychological functioning which is unlikely to be a product of chance.

3.3 HADS Anxiety and Depression Questionnaire

Given the relatively large numbers of patients with elevated anxiety and/or depression scores, the relationship between HADS Anxiety and Depression and the other study variables were explored. A correlation matrix investigating the relationship between the HADS and the other study variables is shown below.

TEST/QUSTIONNAIRE	Correlation with HADS-Anx	SIGN	Correlation with HADS-Dep	SIGN
EXECUTIVE FUNCTIONING				
BADS-Age Scaled Score	0.082	0.660	-0.004	0.982
MCST-Categories	0.012	0.948	-0.223	0.227
MCST-Total Errors	0.059	0.753	0.300	0.101
MCST-% of Perseverative Errors	-0.064	0.733	0.044	0.816
Trails B-Percentile	-0.045	0.810	-0.112	0.547
Verbal Fluency (CFL)-Transformed Score	0.014	0.941	0.005	0.979
COGNITIVE FUNCTIONING				
Block Design- Age Scaled Score	-0.118	0.526	0.067	0.720
Verbal Memory-Immediate Recall(%ile)	0.010	0.958	0.079	0.673
Verbal Memory-Delayed Recall(%ile)	0.264	0.156	0.290	0.114
Visual Memory-Immediate Recall(%ile)	0.070	0.708	0.119	0.523
Visual Memory-Delayed Recall(%ile)	0.131	0.482	0.101	0.586
Verbal Fluency -Animals	0.165	0.375	0.206	0.266
Trails A-Percentile	-0.149	0.423	-0.031	0.869
QUALITY OF LIFE-PATIENTS REPORTS				
QOL-Physical Health	-0.868	<0.001	-0.845	<0.001
QOL-Psychological	-0.705	<0.001	-0.877	<0.001
QOL-Social Relationships	-0.651	<0.001	-0.821	<0.001
QOL-Environment	-0.650	<0.001	-0.791	<0.001
QUALITY OF LIFE-RELATIVES REPORT				
QOL-Physical Health	-0.477	0.007	-0.523	0.003
QOL-Psychological	-0.613	<0.001	-0.626	<0.001
QOL-Social Relationships	-0.574	0.001	-0.590	<0.001
QOL-Environment	-0.343	0.059	-0.389	0.031
PSYCHOSOCIAL FUNCTIONING-PTS				
Physical	0.535	0.002	0.543	0.002
Language	0.617	<0.001	0.488	0.005
Emotional	0.757	<0.001	0.759	<0.001
Dependence	0.559	0.001	0.430	0.016
Subjective	0.658	<0.001	0.594	<0.001
Memory	0.845	0.006	0.510	0.003
Behaviour Change	0.831	<0.001	0.825	<0.001
PSYCHOSOCIAL FUNCTIONING-RELS				
Physical	0.443	0.012	0.390	0.030
Language	0.383	0.034	0.342	0.059
Emotional	0.548	0.001	0.452	0.011
Dependence	0.246	0.181	0.232	0.208
Subjective	0.610	<0.001	0.582	0.001
Memory	0.324	0.075	0.298	0.104
Behaviour Change	0.440	0.013	0.448	0.012
DEX QUESTIONNAIRES				
DEX- Self Rating	0.841	<0.001	0.780	<0.001
DEX- Relatives Rating	0.461	0.009	0.345	0.061

TABLE 9: 2 TAILED CORRELATIONS BETWEEN HADS ANXIETY & DEPRESSION AND OTHER STUDY VARIABLES

These results show that neither HADS anxiety or depression scores are significantly correlated with the neuropsychological data gathered in this study. As would be expected, there were significant correlations between HADS anxiety and depression and patients' and relatives' ratings on the Psychological sub-scale of the WHOQOL-BREF and the Emotional sub-scales of the Questionnaire for SAH Patients and the Questionnaire for Relatives which is not surprising given the overlap in these measures.

In addition, we find that both HADS anxiety and depression scores are highly and significantly correlated (0.01 level of significance) with patients' reports on the 3 other sub-scales of the WHOQOL-BREF (Physical Health, Social Relations and Environment) and only fail to reach significance on the Environment sub-scale for relatives' reports. HADS anxiety and depression are significantly correlated with all but one sub-scales of patients' reports of psychosocial functioning (the correlation between HADS depression and patients reports of Dependence narrowly fails to meet significance). Regarding relatives' reports of psychosocial functioning the table above shows that HADS anxiety is significantly correlated with the Physical and Behaviour Change sub-scales in addition to the Emotional sub-scale while HADS depression is also significantly correlated with the Subjective and Behaviour Change sub-scales. It should be noted that many of the other correlations also near significance. In all cases, high anxiety or depression is related to poorer quality of life and psychosocial functioning.

For the DEX questionnaires we, again, see significant correlations between HADS anxiety and depression for patients' own ratings and a significant correlation between

relatives' ratings and HADS anxiety. In each case, the higher the anxiety or depression, the greater the difficulties reported in the DEX.

3.4 DEX Questionnaires

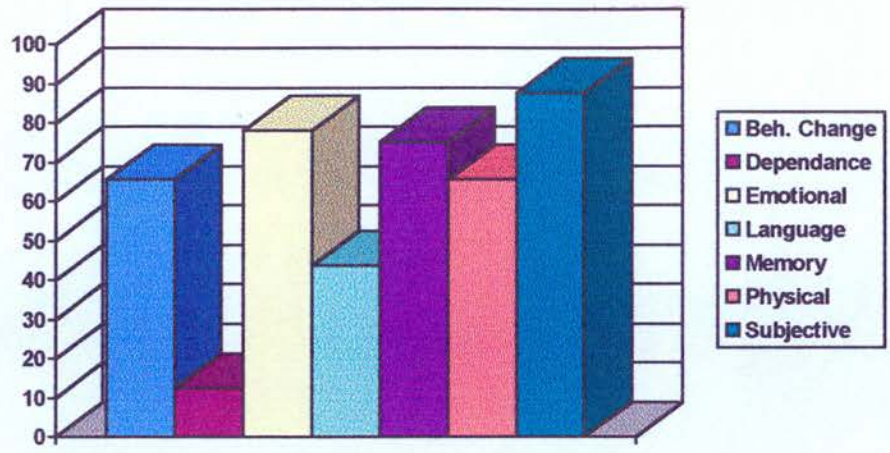
Unfortunately, no normative data is available for the DEX questionnaires although Wilson (1996) does report the means for self- and other ratings for a group of 92 neurological patients, mainly head injuries. The other and self- ratings for this group respectively were 32.9 and 27.2 both of which are significantly more ($t=4.9$ (31), $p=<0.01$ & $t=2.4$ (31), $p=0.02$) at the 0.05 level than the other and self- ratings for the present sample - 18.0 and 19.0 respectively. In addition, Wilson (1996) reports a significant difference between the subjects self- and other ratings, but this was not replicated in the present study ($t=0.22$ (62), $p=0.83$). Wilson also found a significant correlation between relatives' ratings (but not patients' self- reports) of executive functioning and performance on the BADS. No such significant correlations were found in the present study (DEX-Relatives and BADS-Profile score $r=0.02$, $p=0.92$ and DEX-Self Rating and BADS-Profile score $r=0.02$, $p=0.93$).

3.5 Questionnaire For S A H Patients And Questionnaire For Relatives

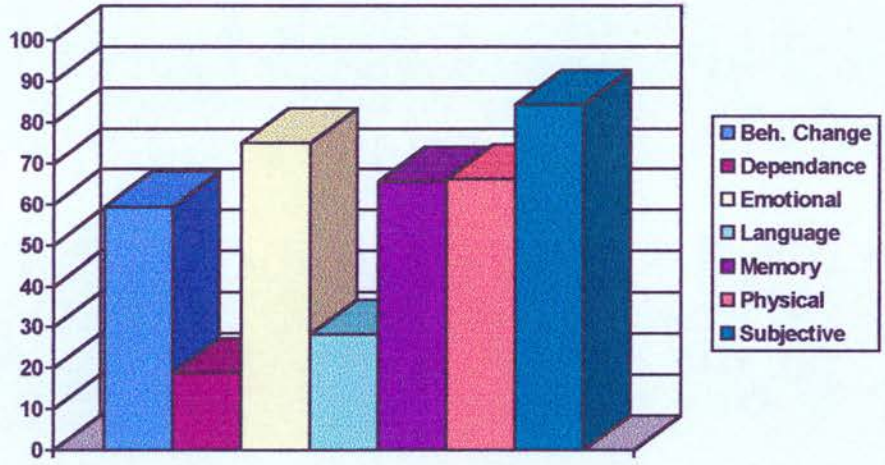
QUESTIONNAIRE SUB-SCALES	PATIENTS' REPORTS	RELATIVES' REPORTS
Physical	1.27	1.05
Language	1.09	0.73
Emotional	1.96	2.43
Dependence	0.26	0.37
Subjective	2.99	2.99
Memory	2.47	3.20
Behaviour Change	1.42	1.59

TABLE 10: SUBJECTS' AND RELATIVES' TRANSFORMED SCORES (0-10) FOR THE 7 SUB-SCALES IN THE 'QUESTIONNAIRE FOR SAH PATIENTS' & THE 'QUESTIONNAIRE FOR RELATIVES'

Patients' and relatives' transformed scores out of 10 for each of the 7 sub-scales of these measures are provided in Table 10 above. Unfortunately, no normative data is available with which to compare these findings. Brooks (1981) reports scores for a group of 55 patients who had suffered severe blunt head injuries one year previously which tend to be somewhat higher than those reported by either patients or relatives in the current sample. This is not surprising given that the current sample consists entirely of 'good recoveries'. The exception is memory problems which are reported as being higher in the present sample. Graphs 1 and 2 below show the percentage of patients with at least a minimal level of reported change (i.e. scores >0) for each of the seven subscales for both patients' and relatives' reports.



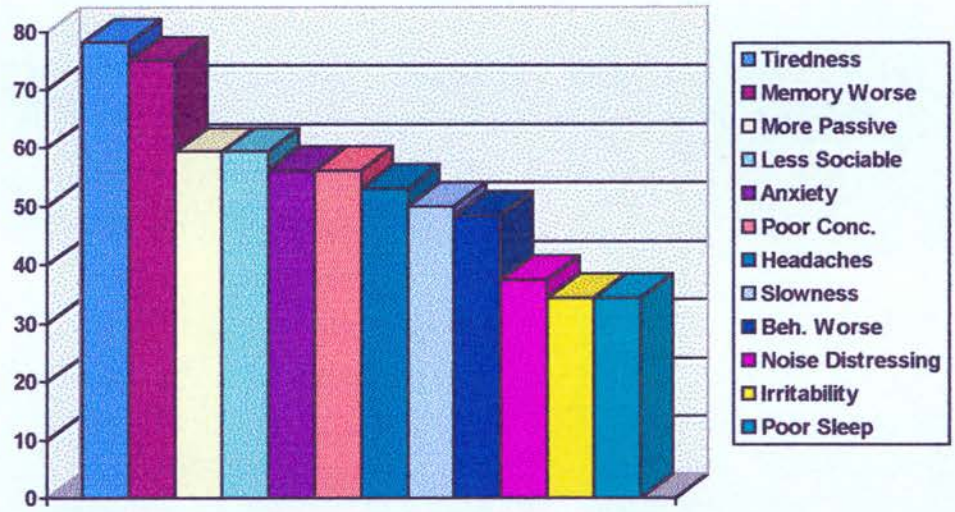
GRAPH 1: PERCENTAGE OF PATIENTS REPORTING SOME CHANGE OR DIFFICULTIES (>0) ON THE 7 SUB-SCALES OF THE 'QUESTIONNAIRE FOR SAH PATIENTS'



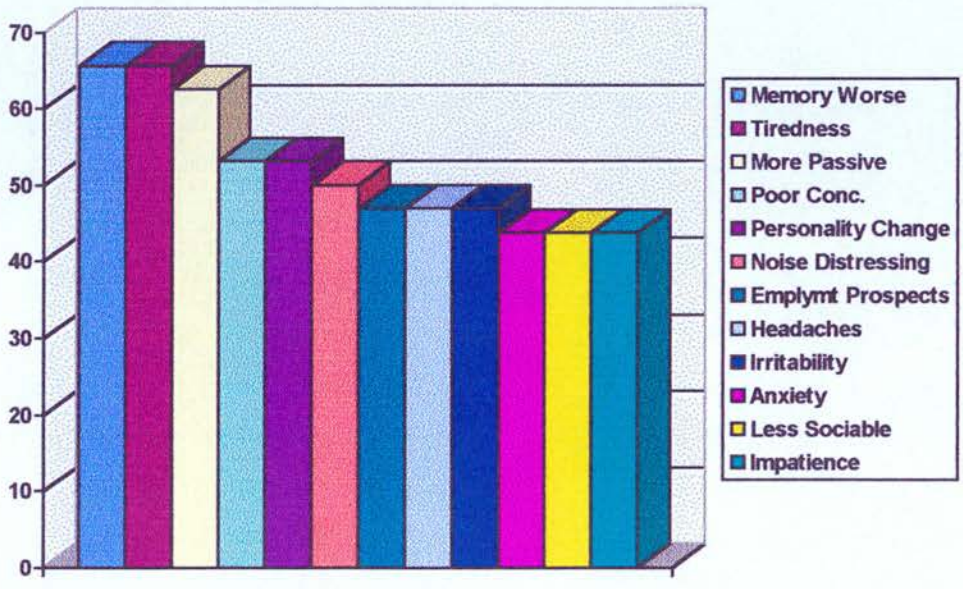
GRAPH 2: THE PERCENTAGE OF SUBJECTS RATED BY RELATIVES AS SHOWING SOME DEGREE OF CHANGE OR DIFFICULTIES (>0) ON THE 'QUESTIONNAIRE FOR RELATIVES'

It can be seen from the above Graphs that the pattern of results are similar for both patients' and relatives' reports. That is, increased levels of dependence and language difficulties are relatively uncommon while behavioural changes, emotional changes, memory problems, physical problems and subjective difficulties are present to at least a minimal degree in over 50% of subjects, with up to 88% of subjects reporting some degree of subjective difficulties.

To give a further flavour of the changes and difficulties reported in these questionnaires the 12 most common difficulties/ changes reported are displayed on the graphs below.



GRAPH 3: TWELVE MOST COMMON CHANGES / DIFFICULTIES REPORTED BY PATIENTS



GRAPH 4: 12 MOST COMMON CHANGES / DIFFICUTIES REPORTED BY RELATIVES

From these graphs it should be noted that over 50% of relatives believed their relative's personality had changed following their aneurysm while the equivalent figure for subjects themselves was 33%. Almost 50% of relatives believed their relative's employment prospects to be adversely affected and some 30% of subjects themselves believed this. Subjects and relatives, where appropriate, were asked to respond to an item pertaining to the subject's interest in their sexual relationship. Twenty five subjects responded to this question and 28% reported less interest while 23 relatives responded and of these 35 % reported that their relative was less interested in their sexual relationship.

Overall the results from these questionnaires show that many subjects perceive themselves as having undergone wide ranging changes and as experiencing ongoing difficulties, and that this perception is largely shared by their close relatives.

4. Executive Functioning

4.1 Hypothesis 3(A); There Will Be A Significant Positive Correlation Between Executive Functioning And Psychosocial Outcome

Tables 11 and 12 show the correlation tables for the main tests of executive functioning employed in this study and the subscales of the Questionnaire for SAH Patients and the Questionnaire for Relatives which are intended to give some indication of psychosocial functioning. As the direction of the effect is being predicted all tests are one-tailed, although a more stringent 0.01 level of significance has been adopted given the number of tests performed.

TEST		BEH. CHANGE	DEPEND ENCE	EMOTI ONAL	LANGU AGE	MEMO RY	PHYSIC AL	SUBJEC TIVE
BADS-ASS	r	-0.15	-0.05	0.13	0.11	0.06	0.22	-0.004
	p	*0.21*	*0.38*	*0.25*	*0.28*	*0.38*	*0.12*	*0.49*
MCST-	r	-0.31	-0.35	-0.23	-0.28	-0.30	-0.09	-0.29
CATS	p	*0.04*	*0.02*	*0.11*	*0.06*	*0.05*	*0.31*	*0.06*
MCST-	r	0.30	0.28	0.20	0.24	0.21	0.14	0.27
ERR	p	*0.05*	*0.06*	*0.14*	*0.09*	*0.12*	*0.22*	*0.06*
MCST-	r	0.43	0.24	0.27	0.27	0.27	0.12	0.30
%PER	p	*0.007*	*0.09*	*0.06*	*0.07*	*0.06*	*0.25*	*0.05*
TRAILS B	r	0.21	0.12	0.12	0.09	-0.03	0.15	0.05
	p	*0.12*	*0.26*	*0.25*	*0.31*	*0.44*	*0.20*	*0.40*
VERBAL	r	-0.00	0.06	0.10	0.12	0.31	0.27	0.05
FLUENCY	p	*0.49*	*0.37*	*0.30*	*0.25*	*0.04*	*0.07*	*0.40*

TABLE 11: ONE-TAILED CORRELATIONS AND SIGNIFICANCE BETWEEN TESTS OF EXECUTIVE FUNCTIONING AND RELATIVES' RATINGS OF PSYCHOSOCIAL FUNCTIONING.

TEST		BEH. CHANGE	DEPEND ENCE	EMOTI ONAL	LANGU AGE	MEMO RY	PHYSIC AL	SUBJEC TIVE
BADS-ASS	r	-0.00	0.07	0.14	0.27	0.07	0.19	0.04
	p	*0.50*	*0.35*	*0.22*	*0.07*	*0.34*	*0.15*	*0.4*
MCST-	r	-0.11	-0.24	-0.03	-0.13	-0.20	-0.12	-0.16
CATS	p	*0.28*	*0.09*	*0.45*	*0.23*	*0.13*	*0.25*	*0.19*
MCST-	r	0.14	0.25	0.04	0.11	0.16	0.20	-0.14
ERR	p	*0.22*	*0.08*	*0.40*	*0.28*	*0.19*	*0.13*	*0.23*
MCST-	r	-0.00	0.00	-0.07	-0.07	0.06	0.10	-0.07
%PER	p	*0.50*	*0.50*	*0.35*	*0.35*	*0.36*	*0.30*	*0.34*
TRAILS B	r	-0.06	-0.01	-0.08	-0.06	-0.14	0.09	-0.07
	p	*0.37*	*0.47*	*0.33*	*0.36*	*0.22*	*0.32*	*0.35*
VERBAL	r	0.10	0.24	0.15	0.14	0.35	0.27	-0.07
FLUENCY	p	*0.30*	*0.09*	*0.20*	*0.22*	*0.02*	*0.07*	*0.35*

TABLE 12: ONE-TAILED CORRELATIONS AND SIGNIFICANCE BETWEEN TESTS OF EXECUTIVE FUNCTIONING AND PATIENTS' REPORTS OF PSYCHOSOCIAL FUNCTIONING

It can be seen that only 1 correlation reaches significance at the 0.01 level with the percentage of perseverative errors on the MCST being significantly correlated with relatives reports of behaviour change. There are a number of modest correlations between relatives' reports and measures from the MCST in the predicted direction but these largely fail to meet the more demanding level of significance adopted. The correlations between the other tests of executive functioning- BADS, Trails B & Verbal Fluency - and the various indices of psychosocial functioning are at best small and none reach statistical significance regardless as to whether we examine patients' or relatives' reports.

Therefore, with the exception of a number of modest correlations between MCST and relatives' reports of psychosocial functioning, there is no evidence to support the hypothesis that there is a significant positive correlation between executive functioning and psychosocial outcome.

4.2 Hypothesis 3(B): There Will Be A Significant Positive Correlation Between Executive Functioning And Quality Of Life.

TEST		RQOL1 PHYSICAL	RQOL2 PSYCHOL.	RQOL3 SOC. RELS.	RQOL4 ENVIRON.
BADS-ASS	r	-0.02	0.01	0.11	0.00
	p	*0.46*	*0.47*	*0.27*	*0.49*
MCST-CATS	r	0.22	0.24	0.33	0.20
	p	*0.11*	*0.09*	*0.03*	*0.14*
MCST-ERR	r	-0.23	-0.33	-0.36	-0.24
	p	*0.10*	*0.03*	*0.02*	*0.09*
MCST-%PER	r	-0.29	-0.32	-0.30	-0.34
	p	*0.05*	*0.04*	*0.05*	*0.03*
TRAILS B	r	-0.16	-0.29	-0.28	-0.26
	p	*0.19*	*0.05*	*0.06*	*0.08*
VERBAL FLUENCY	r	-0.10	-0.16	-0.09	-0.17
	p	*0.30*	*0.20*	*0.32*	*0.17*

TABLE 13: ONE-TAILED CORRELATIOS AND SIGNIFICANCE BETWEEN TESTS OF EXECUTIVE FUNCTIONING AND RELATIVES' REPORTS OF QUALITY OF LIFE

TEST		QOL1 PHYSICAL	QOL2 PSYCHOL.	QOL3 SOC. RELS.	QOL4 ENVIRON.
BADS-ASS	r	-0.08	-0.06	0.18	-0.12
	p	*0.33*	*0.37*	*0.16*	*0.25*
MCST-CATS	r	0.06	0.12	0.20	0.04
	p	*0.38*	*0.26*	*0.13*	*0.42*
MCST-ERR	r	-0.10	-0.18	-0.23	-0.15
	p	*0.30*	*0.17*	*0.10*	*0.20*
MCST-%PER	r	-0.09	-0.12	-0.09	0.08
	p	*0.31*	*0.26*	*0.32*	*0.33*
TRAILS B	r	0.07	-0.04	-0.09	-0.09
	p	*0.35*	*0.41*	*0.31*	*0.32*
VERBAL FLUENCY	r	-0.08	0.03	0.11	-0.02
	p	*0.34*	*0.45*	*0.27*	*0.45*

TABLE 14: ONE-TAILED CORRELATIONS AND SIGNIFICANCE BETWEEN TESTS OF EXECUTIVE FUNCTIONING AND PATIENTS' REPORTS OF QUALITY OF LIFE

Taking a more stringent 0.01 level of significance none of the correlations in Tables 13 & 14 above reach significance. Looking at Table 13, however, there would appear to be a number of consistent, if modest, correlations between poor performance on MCST and Trails B and relatives' reports of poorer quality of life, although none of these reach the required level of significance. Overall, the results show no relationship between executive functioning and patients' reports of quality of life but would appear to reveal at least a trend for performance on some tests of executive functioning to be associated with relatives' reports of quality of life.

5. Acute Factors

5.1 Hypothesis 4(A): Older Age At Onset Will Be A Significant Predictor Of Poorer Cognitive Functioning, Executive Functioning, Psychosocial Outcome And Quality Of Life.

Below are tables detailing the correlations between age at the onset of the SAH and the variables outlined in the hypothesis.

		BADS-ASS	MCST-CATS	MCST-ERRORS	MCST-%PER	TRAILS B	VERBAL FLUENCY
AGE	r	-0.20	-0.35	0.25	0.20	0.14	-0.05
	p	*0.12*	*0.02*	*0.07*	*0.12*	*0.20*	*0.39*

TABLE 15: ONE_TAILED CORRELATIONS FOR AGE AND TESTS OF EXECUTIVE FUNCTIONING

None of the correlations reach significance at the p= 0.01 level although there is a tendency for older patients to achieve less categories and make more errors on the MCST. This may be only the normal effects of ageing as the other variables in the correlation table which show smaller correlations with age are already age corrected while the MCST scores are not. While age at time of assessment did not correlate significantly with the MCST scores (or with any of the study variables) when a partial

correlation was performed, controlling for age at time of assessment, the size of the correlations was considerably reduced demonstrating that there was no independent correlation between age at operation and MCST (correlation between MCST-errors and Age at Operation controlling for Age at Assessment- r=-0.08, p=0.33: correlation between MCST-categories and Age at Operation controlling for Age at Assessment- r=-0.03, p=0.43).

	BLK DSGN	VER MEM IMMED	VER MEM DELAY	VIS MEM IMMED	VIS MEM DELAY	TRAILS A	ANIMA LS
AGE r	0.01	-0.01	-0.03	-0.13	-0.19	-0.09	-0.22
p	*0.49*	*0.49*	*0.43*	*0.23*	*0.14*	*0.31*	*0.09*

TABLE 16: ONE TAILED CORRELATIONS FOR AGE AT OPERATION AND TESTS OF COGNITIVE FUNCTIONING

While the majority of the correlations are in the expected direction, with subjects who were older at the time of their bleed doing less well on tests of cognitive functioning, none of these correlations achieve significance.

	RBEH CHANGE	RDEPEN-DENCE	REMOTI-ONAL	RLANGU-AGE	RMEMO-RY	RPHYSI-CAL	RSUBJE-CTIVE
AGE r	0.19	0.37	-0.01	0.20	-0.02	-0.16	0.01
p	*0.14*	*0.02*	*0.47*	*0.14*	*0.47*	*0.20*	*0.48*

TABLE 17: CORRELATIONS BETWEEN AGE AT OPERATION AND RELATIVES' REPORTS OF PSYCHOSOCIAL FUNCTIONING

Again, the scores are largely in the predicted direction, but none of the correlations reach significance. There is a trend for relatives to rate subjects who were older at the time of the bleed as more dependant although this may be simply a function of age alone as these scores are not age corrected, and indeed when age at assessment was entered as a control variable in a partial correlation this significant relationship disappeared (r=0.07, p=0.344).

		BEH CHANGE	DEPEN-DENCE	EMOTI-ONAL	LANGU-AGE	MEMORY	PHYSI-CAL	SUBJE-CTIVE
AGE	r	-0.05	0.17	-0.24	-0.04	-0.25	-0.22	-0.31
	p	*0.38*	*0.17*	*0.09*	*0.42*	*0.08*	*0.18*	*0.04*

TABLE 18: ONE TAILED CORRELATIONS BETWEEN AGE AT OPERATION AND PATIENTS REPORTS OF PSYCHOSOCIAL FUNCTIONING

No correlations reach significance and the trend would appear to be in the opposite direction to that predicted, with older age at the time of bleed tending to be associated with patients' reporting less psychosocial difficulties.

		RQOL1 PHYSICAL	RQOL2 PSYCHOL	RQOL3 SOC. RELS	QOL4 ENVIRON.
AGE	r	-0.19	-0.04	0.02	0.03
	p	*0.18*	*0.42*	*0.46*	*0.44*

TABLE 19: ONE TAILED CORRELATIONS BETWEEN AGE AT OPERATION AND RELATIVES' REPORTS OF QUALITY OF LIFE

No significant correlations between age at operation and relatives' reports of quality of life were found.

		QOL1 PHYSICAL	QOL2 PSYCHOL	QOL3 SOC. RELS	QOL4 ENVIRON.
AGE	r	0.08	0.17	0.07	0.29
	p	*0.34*	*0.17*	*0.35*	*0.05*

TABLE 20: ONE TAILED CORRELATIONS BETWEEN AGE AT OPERATION AND PATIENTS' REPORTS OF QUALITY OF LIFE

No significant correlations between age at the time of the bleed and current quality of life were found. The correlations were in the opposite direction to that predicted with patients who were older at the time of the operation tending to rate their quality of life as slightly but not significantly higher.

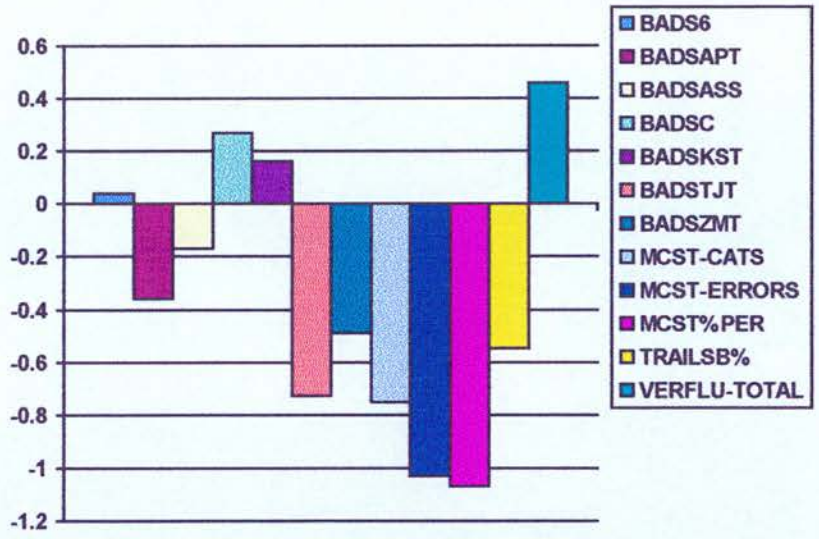
Overall, the results lend little support to the hypothesis that older age at the time of the bleed would be significantly associated with poorer executive functioning, cognitive functioning, psychosocial functioning and quality of life. Where the data does show

modest correlations in line with this hypothesis, this tends to be for variables that are not age corrected and therefore, we may simply be seeing the normal effects of ageing on these functions. When this was explored using partial correlations any significant findings tended to disappear. Furthermore, there would appear to be a slight trend for subjects who were older at the time of their bleed to report slightly higher as opposed to lower psychosocial functioning and quality of life.

5.2 Hypothesis 4(B):Neither Pre Nor Post Operative Complications Will Be Significantly Related To Cognitive Or Executive Functioning

Due to the small number of patients falling into each category of pre and post-operative complications, and instances where the exact nature of the complication could not be defined, the presence or absence of both pre and post operative complications was merely noted for each patient. This information was unavailable for 1 subject but otherwise it was found that 9 out of 35 (26%) had pre-operative complications and 10 subjects (29%) had post operative complications. The presence or absence of pre and post operative complications were used individually as factors in multivariate analysis to study the above hypothesis. Neither cognitive functions nor executive functions were found to differ significantly as a result of pre-operative complications (exact $F=1.73$ (7,27), $p=0.14$; exact $F=0.66$ (12,22), $p=0.77$). Similarly, the presence of post -operative complications had no significant impact on cognitive functioning (exact $F= 0.62$ (7,27), $p=0.73$) but did have an impact on executive functioning (exact $F=2.45$ (12,22), $p=0.03$) at the 0.05 level of significance. Two of the univariate F-tests generated by this analysis were significant at the more stringent 0.01 level with subjects with post-operative complications being significantly more likely to make more overall errors on the MCST ($F=9.08$ (1,33), $p=0.005$) and a higher percentage of perseverative errors ($F=10.22$ (1,33), $p=0.003$). Overall, the results show a trend for subjects who have

post-operative complications to do less well on tests of executive functioning This is displayed in the Graph below where a negative score indicates those with post-operative complications did less well compared to those without such complications, and a positive score the reverse and as such on 8 out of the 12 variables analysed, those with post-operative complications did less well. These are displayed as differences in standardised scores to allow easier comparison between different tests scored on differing scales.



GRAPH 5: DIFFERENCES IN MEAN STANDARDISED SCORES BETWEEN THOSE WITH AND WITHOUT POST OPERATIVE COMPLICATIONS(Note where a higher score indicates a poorer performance eg MCST-ERRORS, this has been reversed for easier interpretation.)

To conclude, there is no evidence to suggest that cognitive functioning is significantly influenced by pre or post operative complications but there is some evidence to suggest that post-operative complications are associated with poorer executive though not cognitive functioning.

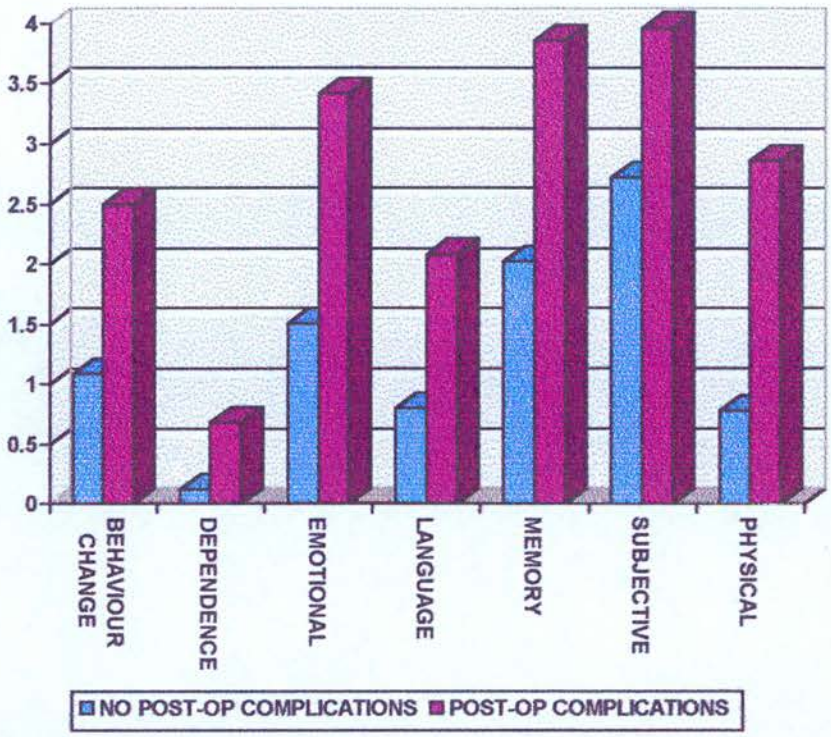
5.3 Hypothesis 4(C): Post Operative Complications Will Be Associated With Poorer Psychosocial Functioning And Quality Of Life.

The presence and absence of pre and post operative complications were used as factors in multivariate analysis to examine the hypothesis that post operative complications would be significantly associated with poorer psychosocial functioning and quality of life.

VARIABLE GROUPING	EXACT F	SIGN. OF F
POST OPERATIVE COMPLICATIONS		
Quality of Life- Patients	0.69 (6,24)	0.660
Psychosocial Functioning-Patients	2.50 (7,23)	0.046
Quality of Life- Relatives	1.47 (6,24)	0.229
Psychosocial Functioning-Relatives	1.42 (7,23)	0.246
PRE OPERATIVE COMPLICATIONS		
Quality of Life- Patients	1.10(6,24)	0.389
Psychosocial Functioning-Patients	0.61 (7,23)	0.740
Quality of Life- Relatives	0.08 (6,24)	0.615
Psychosocial Functioning-Relatives	1,20 (7,23)	0.340

TABLE 21: MULTIVARIATE ANALYSES COMPARING THOSE WITH AND WITHOUT POST OPERATIVE AND PRE OPERATIVE COMPLICATIONS ON MEASURES OF QUALITY OF LIFE AND PSYCHOSOCIAL FUNCTIONING

This table shows a significant difference between those with and without post operative complications and patients' reports of psychosocial functioning, with none of the other analyses reaching significance at the 0.05 level. The nature of the relationship between post operative complications and patients' reports of psychosocial functioning is clarified in the graph below.



GRAPH 6: MEAN TRANSFORMED SCORES OF THOSE WITH AND WITHOUT POST OPERATIVE COMPLICATIONS ON PATIENTS' RATINGS OF PSYCHOSOCIAL FUNCTIONING

It can be seen from this graph that on each sub-scale of the Questionnaire for SAH Patients those with post operative complications scored higher than those without, that is, they reported a greater number and / or severity of changes and difficulties. Examining the univariate F tests produced in the above analysis, three of these - emotional changes ($F=7.17$ (1,29), $p=0.01$), memory problems ($F=6.88$ (1,29), $p=0.01$), and physical problems ($F=16.63$ (1,29), $p=0.00$) were significantly different at the 0.01 level. In addition, when DEX scores and HADS anxiety and depression scores were compared for those with and without post-operative complications, patients with post-operative complications showed a trend towards higher anxiety scores and significantly higher depression scores ($t=2.61$, $p=0.01$). There was also a trend towards patients with post-operative complications having higher self and other DEX ratings although these failed to reach significance. Thus, hypothesis 2C is partly supported in that patients with post-operative complications perceive themselves as having poorer

psychosocial functioning, although contrary to the hypothesis there is no difference in quality of life between the groups.

5.4 Hypothesis 4(D): There Will Be No Relationship Between Site Of Aneurysm And Any Of The Outcome Variables.

Due to the variety of aneurysm sites within the group and consequently the small numbers with aneurysms in any given location the procedure followed by Tidswell et al (1995) was adopted where subjects were split into those with anterior (N=8) and non-anterior aneurysms (N=28). As discussed earlier, there is some belief that those with anterior lesions will perform more poorly than those with aneurysms in other locations. Whether the aneurysm was anterior or non-anterior was then used as a factor in multivariate analysis to investigate the association between site of aneurysm and the 4 main variable groupings in the study. The results are shown below.

VARIABLE GROUPING	EXACT F	SIGNIFICANCE OF F
Executive Functioning	2.28	0.063 (12, 28)
Cognitive Functioning	0.47	0.850 (7,28)
Quality of Life- Patients' Rating	0.52	0.722 (4,25)
Quality of Life- Relatives' Rating	0.17	0.954 (4,25)
Psychosocial Functioning - Pts Rating	1.42	0.243 (7,24)
Psychosocial Functioning- Rel Rating	1.47	0.223 (7,24)

TABLE 22: MULTIVARIATE ANALYSES COMPARING THOSE WITH ANTERIOR AND NON-ANTERIOR ANEURYSMS ON STUDY VARIABLES

It can be seen that none of the analyses reached significance at the 0.05 level which lends support to the hypothesis that aneurysm location would not have a significant impact on the variables studied. Furthermore, examining the univariate F tests produced by these analyses shows none of these reached significance at the more stringent 0.01 level.

6 Self vs. Others Reports

6.1 Hypothesis 5(A): There Will Be A Tendency For Patients To Under-Report Reduced Quality Of Life And Psychosocial Difficulties (Especially Behavioural And Emotional Changes) In Comparison To Relatives.

As already noted there was no significant difference between patients and relatives reports on the DEX questionnaires. Whether there were any significant differences between patients' and relatives' ratings of quality of life and psychosocial functioning was investigated using multivariate analysis. No significant difference was found between patients' and relatives' reports of psychosocial functioning (Exact F=1.36 (7,56), p=0.240) and similarly no difference was found for ratings of quality of life (Exact F= 2.3 (5,58), p=0.069) although for the latter relatives' reported slightly lower quality of life scores in 3 out of the 4 domains (Physical Health, Social Relations and Environment) which may account for this analysis nearing significance. None of the univariate F tests produced by either analysis were significant. Overall, we are forced to reject the hypothesis and conclude that there are no significant differences between subjects' and relatives' reports.

7. Multiple Regression Analyses

From the preceeding results variables that showed some association at the 0.05 level of significance or below, with some aspect of either patients' or relatives' ratings of quality of life or psychosocial functioning were selected for inclusion in multiple regression analysis. It was hoped that in doing so those variables that contribute to poor quality of life and psychosocial functioning would be elucidated as well as

providing some idea of their relative contribution. This may allow us to develop a model to help explain why some individuals with a 'good recovery' following their SAH go on to experience reduced quality of life and psychosocial functioning.

The variables entered in each regression analysis are presented in Table 23 and the results of these stepwise multiple regression analyses for each sub-scale of the patients and relatives questionnaires are displayed in Tables 24-27.

VARIABLE GROUPINGS			
EXECUTIVE FUNCTIONING	COGNITIVE FUNCTIONING	ACUTE FACTORS	PSYCHOLOGICAL FACTORS
MCST-Categories MCST- Errors MCST- % Per. Errors Trails B- %ile Verbal Fluency	Verbal Mem.- Delayed Block Design	Post-op Complications Age at Assessment	HADS- Anxiety HADS- Depression

TABLE 23: VARIABLES SELECTED FOR USE IN MULTIPLE REGRESSION ANALYSES

7.1 Patients' Ratings of Quality of Life

DEPENDENT VARIABLE	VARIABLES IN EQUATION	MULTIPLE R	ADJUSTED Rsq.	CONTRIB TO Rsq.	F	SIGN OF F
QOL- Physical Health	Step 1- HADS Anxiety	0.876	0.759	0.759	92.27	<0.001
	Step 2-Age at Assessment	0.908	0.812	0.053	63.62	<0.001
	Step 3-HADS Depression	0.926	0.841	0.029	57.11	<0.001
QOL2 - Psychological	Step 1- HADS Depression	0.876	0.760	0.760	92.61	<0.001
QOL3- Social Rels.	Step 1- HADS Depression	0.819	0.659	0.659	56.99	<0.001
	Step 2-Block Design	0.883	0.762	0.103	47.55	<0.001
	Step 3- HADS Anxiety	0.902	0.792	0.030	37.85	<0.001
	Step 4- Post-Op Comps.	0.920	0.821	0.029	34.26	<0.001
QOL4- Environment	Step 1- HADS Depression	0.799	0.625	0.625	49.37	<0.001

TABLE 24: MULTIPLE REGRESSION ANALYSES FOR PATIENTS' RATINGS OF QUALITY OF LIFE

It is clear from the above table that patients' ratings of their quality of life is highly related to their HADS depression, and to a lesser extent their HADS anxiety scores where greater levels of reported depression and anxiety are associated with poorer quality of life. It can also be seen that age is associated with physical health, with older

subjects reporting a poorer quality of physical health. Block Design and post operative complications were found to independently contribute to patients' ratings of social relations where higher scores on Block Design was associated with greater satisfaction with social relationships and post operative complications associated with poorer social relations.

7.2 Relatives' Ratings of Quality of Life

DEPENDENT VARIABLE	VARIABLES IN EQUATION	MULTIPLE R	ADJUSTED Rsq.	CONTRIB TO Rsq.	F	SIGN OF F
RQOL1-Physical Hlth	Step 1- HADS Depression	0.522	0.246	0.246	10.47	0.003
	Step 2- MCST-%Persev.	0.647	0.376	0.130	9.74	<0.001
RQOL2-Psychol.	Step 1- HADS Depression	0.619	0.361	0.361	17.36	<0.001
	Step 2- MCST-%Persev.	0.711	0.469	0.108	13.80	<0.001
RQOL3- Social Rels	Step 1- HADS Depression	0.581	0.313	0.313	14.24	<0.001
	Step 2- MCST-%Persev.	0.667	0.403	0.09	10.80	<0.001
RQOL4- Environment	Step 1- HADS Depression	0.397	0.127	0.127	5.23	0.029
	Step 2- MCST-%Persev.	0.531	0.229	0.102	5.30	0.011

TABLE 25: MULTIPLE REGRESSION ANALYSES FOR RELATIVES' RATINGS OF QUALITY OF LIFE

This table shows a surprising degree of consistency across the 4 quality of life sub-scales with patients' ratings of HADS depression and the percentage of perseverative errors they made being the only variables independently related to relatives' ratings of quality of life. The amount of variance these measures explain differs somewhat between sub-scales - 22.9% of the Environment sub-scale to 46.9% of the Psychological sub-scale - which even in the best case leaves more than half the variance unaccounted for.

7.3 Patients' Ratings of Psychosocial Functioning

DEPENDENT VARIABLE	VARIABLES IN EQUATION	MULTIPLE R	ADJUSTED Rsq.	CONTRIB TO Rsq.	F	SIGN OF F
Behaviour Change	Step 1- HADS Anxiety	0.836	0.688	0.688	64.83	<0.001
	Step 2- Age at Assessment	0.870	0.738	0.050	41.86	<0.001
	Step 3- Age at Aneurysm	0.893	0.774	0.036	34.15	<0.001
Dependence	Step 1- HADS Anxiety	0.560	0.289	0.289	12.78	0.001
	Step 2- Age at Assessment	0.708	0.465	0.176	13.60	<0.001
Emotional	Step 1- HADS Depression	0.755	0.554	0.554	37.08	<0.001
Language	Step 1- HADS Anxiety	0.608	0.347	0.347	16.42	<0.001
Memory	Step 1- HADS Depression	0.507	0.230	0.230	9.68	0.004
	Step 2- Verbal Fluency	0.607	0.322	0.092	7.89	0.002
Physical	Step 1- Post -Op Comps.	0.609	0.348	0.348	16.49	<0.001
	Step 2- HADS Anxiety	0.705	0.459	0.111	13.31	<0.001
Subjective	Step 1- HADS Anxiety	0.653	0.406	0.406	20.80	<0.001

TABLE 26: MULTIPLE REGRESSION ANALYSES FOR SUBJECTS' RATINGS OF PSYCHOSOCIAL FUNCTIONING

This Table shows that HADS anxiety and depression are again strongly correlated with the outcome variables, in this case psychosocial functioning as reported by subjects. In addition, it can be seen that age contributes independently to the equations for the sub-scales Behaviour Change and Dependence with older subjects showing more behaviour change and greater dependence. Verbal Fluency was found to be independently associated with Dependence and Memory with better scores on verbal fluency being related to reports of greater dependence and memory problems. Post-operative complications was one of two variables independently associated with the Physical sub-scale and accounted for most of the variance explained. Perhaps not surprisingly, those who had post-operative complications reported more physical problems.

7.4 Relatives' Reports Of Psychosocial Functioning

DEPENDENT VARIABLE	VARIABLES IN EQUATION	MULTIPLE R	ADJUSTED Rsq.	CONTRIB TO Rsq.	F	SIGN OF F
Behaviour Change	Step 1- MCST% Persev	0.460	0.184	0.184	7.53	0.010
	Step 2- HADS Anxiety	0.650	0.380	0.196	9.89	<0.001
Dependence	Step 1- Age at Assessment	0.373	0.108	0.108	4.52	0.043
	Step 2- HADS Anxiety	0.533	0.231	0.123	5.35	0.011
Emotional	Step 1- HADS Anxiety	0.533	0.259	0.259	11.12	0.002
	Step 2- MCST% Persev	0.624	0.344	0.085	8.60	0.001
Language	Step 1- HADS Anxiety	0.371	0.107	0.107	4.47	0.044
	Step 2- Age at Assessment	0.535	0.234	0.127	5.42	0.010
Memory	NO VARIABLES ENTERED	-	-	-	-	-
Physical	Step 1- Post -Op Comps	0.512	0.236	0.236	9.94	0.004
Subjective	Step 1- HADS Anxiety	0.606	0.345	0.345	16.27	<0.001
	Step 2- MCST% Persev	0.721	0.485	0.140	14.65	<0.001

TABLE 27: MULTIPLE REGRESSION ANALYSES FOR RELATIVES' RATINGS OF PSYCHOSOCIAL FUNCTIONING

For 5 out of the 7 sub-scales (Behaviour Change, Dependence, Emotional, Language, and Subjective) HADS anxiety is a significant contributor to the multiple regression equation with on each occasion higher anxiety scores being associated with poorer psychosocial functioning. MCST percentage of perseverative errors was found to contribute independently to 3 sub-scales - Behaviour Change, Subjective and Emotional - with in each case the higher the percentage of perseverative errors the poorer the relatives' rating of psychosocial functioning. Age was associated with the Dependence and Language sub-scales with older subjects reported as doing less well on these sub-scales. Post-operative complications was the only variable considered that independently contributed to the Physical sub-scale with, similarly to patients, relatives reporting that those with post operative complications have more physical problems. None of the variables considered reached significance for the Memory sub-scale.

In conclusion, these exploratory multiple regression analyses show that of the variables considered affective state in terms of HADS anxiety and depression scores independently account for a significant amount of the variance in the outcome measures employed in this study. MCST percentage of perseverative errors added significantly to the prediction of particularly relatives' reports. In addition, the presence of post operative complications showed an independent relationship with some measures of poorer outcome, and older subjects on the whole showed poorer outcome on a number of subscales.

DISCUSSION

1.Time post aneurysm

Despite the two subject groups differing widely in their length of time post bleed - a mean of just over a year for the early group and just over six years for the late group there are no detectable significant differences in terms of executive functioning, cognitive functioning, psychosocial functioning, and quality of life. This would be acceptable if a good recovery meant an absence of deficits, but clearly this is not necessarily the case. Instead, the results would appear to suggest that any deficits that are present in terms of cognitive functioning, executive functioning, psychosocial functioning, and quality of life at one year post bleed are still present at six years post bleed with no significant amelioration in the intervening period. This strengthens and extends the findings of previous research where cognitive deficits were not correlated with time post surgery (e.g. Stenhouse et al 1991, Ljunggren et al 1985) and combined with the longitudinal study by Ogden et al (1995) which showed that a group of mainly executive deficits altered little between 10 weeks and a year post aneurysm rupture adds weight to the argument that there may be a range of cognitive and executive deficits that are apparent as little as 3 months post aneurysm and thereafter remain stable, if left unattended.

Additionally, this study demonstrated no significant change in quality of life and psychosocial functioning over time. This in part reflects the experience of Brooks et al (1986, 1981) who reports no decline in relatives' reports of psychosocial deficits in the

same group of 42 head injured patients reviewed one and five years post injury, and for Brooks sample there was a tendency for psychosocial problems to worsen over time. These findings suggest that if cognitive or psychosocial deficits that are amenable to remediation are over looked in the post-operative period when the SAH patient is receiving regular review, then we are condemning that patient to ongoing difficulties that show little or no spontaneous recovery.

2. Comparisons With Normative Data And Clinically Significant Findings

The results reported in section 3 (beginning page 69) clearly show that a considerable proportion of aneurysm patients despite, being classed as a 'good recovery' and despite having estimated pre-morbid Full Scale IQs in the average range or above, show a range of significant deficits. That is, in comparison to normative data, the sample as a whole, shows significantly reduced performance on tests of executive functioning(BADS, MCST: with, for example, the groups' mean BADS- age scaled score being 1 standard deviation lower than normative data), memory (verbal memory immediate and delayed), and word fluency- animals. These results are similar to those reported by Tidswell (1995) who reports impaired performance on similar measures compared to normative data (Wisconsin Card Sorting Test, verbal memory immediate recall, word fluency animals) for a group of 37 unselected patients (one would therefore assume that not all had made a good recovery).

When we examine clinically significant deficits a similar picture emerges with up to 19% of the sample showing impaired executive functioning and up to 19% impaired memory. Some aspects of quality of life are impaired in up to 31 % of the sample, a

findings that is missed when the group mean is compared with normative data where for both subjects and relatives the results were non- significant. A further 10 to 20 % can be added to these figures if we also consider subjects with scores in the borderline range. In terms of individual subjects, these figures translate into 33 % of the sample having 4 of more scores in the borderline or impaired range on the 12 primary measures of executive and cognitive functioning.

If these findings are compared with previous research (see Table 2, page 17 and Table 3, page 27) it can be seen that the present sample generally showed a lower level of clinically significant deficits. This is perhaps not surprising when we compare the results against studies that also had subjects with neurological deficits in their sample (Table 2) but even in comparison to the study by Hutter and Gilsbach (1993) (Table 3) where only patients who had made good recoveries were included, the present sample shows less clinically significant deficits. For example, they report some 21% impaired in verbal long term memory as opposed to only 3 % of the present sample and, overall, some 54 % of their sample had impaired performances on 3 or more out of 20 sub-scales compared to only 25% of the present sample having impaired performances on 2 or more out of 12 sub scales. When scores in the borderline range are also included we find a far more comparable figure with some 58% of the present sample having 2 or more sub scale scores in the impaired of borderline range, suggesting that a considerable percentage of the current sample experience low level cognitive and executive impairment which narrowly fails to meet the strict criteria of clinical significance.

Why a smaller percentage of the present sample shows significant deficits or, similarly, why a comparable number show less severe deficits is unclear. Test selection may play some part with the possibility that Hutter and Gilsbach (1993) employed more sensitive tests. Another difference between the studies is the number of males in the sample (42% of the Hutter and Gilsbach sample compared to only 8.3% of the present sample) although Hutter and Gilsbach (1993) reports no sex differences in relation to cognitive performance. Despite the fact that the present study revealed less clinically significant deficits in comparison to some previous findings, this should not side track us from the finding that some 25 % of the sample had clinically significant deficits on at least two aspects of cognitive of executive functioning and perhaps up to some 58% of the sample displayed signs of at least low level cognitive or executive dysfunctioning.

When we turn to psychosocial functioning we find that for a large proportion of patients there is evidence of at least a minimal level of psychosocial change, for example, up to 88 % of patients reporting a degree of change on the subjective sub-scale (e.g. 15 % of patients report that 'slowness' is rather worse' or 'much worse' since the bleed). When we compare the current findings against those in Table 4 (page 37), which lists psychosocial outcome from a number of studies of aneurysm patients, we find that generally that the current sample reports comparable levels of psychosocial change. For example, in Hutter et al's (1993) sample 17% reported reduced concentration, 47% poorer sleep, and 30 % headaches while the comparable figures for the present sample were 57%, 33 %, and 52% respectively. Vilkki et al (1990) reports impaired work status in some 25 % of the sample, and using the same criteria (i.e. success or failure to return to gainful employment) of the 26 patients in the

present sample employed prior to their bleed 19% failed to return to employment. Ljunggren et al (1985) reports that 70 % of subjects complained of lack of initiative, fatigue, and exhaustion which compares with the high numbers of both patients and relatives reporting increased passivity and tiredness (see Graphs 1 and 2). Ljunggren et al (1985) also reports emotional changes in some 75% of their sample and memory dysfunction in 58% while the equivalent figures for patients' self- reports in the present sample are 79% and 75% respectively (Graph 1, page 79). In addition, the present study demonstrated that over half the sample were perceived as having undergone a personality change since their bleed, half were seen as having reduced employment prospects, and some 35% were reported as less interested in their sexual relationship (Ljunggren et al 1985 reports 20 % experiencing reduced libido).

All in all, it can be seen that the sample reports extensive and wide ranging psychosocial changes which compares to the levels reported in studies, most of which were not confined to only subjects with good recoveries. As already noted, this sample as a whole reported less difficulties on this measure of psychosocial functioning than a group of head injured patients reported by Brooks et al (1981, 1986). The pattern of results, however, is reasonably similar with subjective and emotional difficulties being the most commonly reported in both samples and reduced dependence least reported. There was a greater tendency in the present sample to report memory problems and less reporting of language difficulties.

Almost 20 % of the present sample displayed moderate to severe anxiety on the HADS and this figure rises to 35.5 % if we also include those in the mild range. Only 2 subjects (6.4%) scored in the moderate to severe range for depression, and this figure

only rises to approximately 10 % when we include those in the mild range. The incidence of depression following all strokes is generally found to be high, for example, Robinson and Starkstein (1989, 1990) report 30 to 40 % of stroke patients suffering long term depression. Looking more specifically at S A H patients Tidswell (1995) reports that 16% of their sample were depressed on the Beck's Depression Inventory (B D I) while Ogden et al (1993) reports 20 % in the depressed range at one year post surgery using the same measure. Hutter and Gilsbach report 30% of their sample were substantially depressed also using the B D I but suggest that there is some overlap between the B D I and the general sequlae following an S A H which may inflate the scores, and hence the numbers rated as depressed. The present study attempted to overcome this by use of the H A D S where there is less overlap and this measure also includes a rating of anxiety. The result is we are finding lower levels of depression, but high levels of anxiety suggesting that affective disorders in general are common post S A H, but perhaps more work needs to be done to define their exact nature.

It seems remarkable that a sample, where 25 % have demonstrable clinically significant cognitive and executive impairment, 41% are rated as impaired in at least one aspect of their quality of life, and half have personality change and reduced employment prospects, can consist entirely of good recoveries. While a 'good recovery' on the Glasgow Outcome Scale was never meant to imply a full recovery, the present findings would suggest that although these patients may not have neurological impairment a substantial number have possibly permanent clinically significant cognitive and psychosocial impairments that the system is routinely missing or ignoring by labelling these patients as 'good recoveries'. It would appear to follow logically from these findings that the present system adopted in most areas for following up S A H patients

needs to be reviewed in order to prevent these patients slipping through the net. At the very least, the neurosurgeon who treated the patient should not be the one to review her or him to remove the natural bias this introduces (few grateful patients are likely to mention so called minor complaints to the person that 'saved their life', and most surgeons are more than happy to hear how well their cases are doing). In addition, we have to move away from the focus on neurological problems to include cognitive and psychosocial deficits which a substantial number of studies show are relatively common and perhaps permanent if not addressed. If this means that other professionals have to be included in the review procedure (e.g. neuropsychologists) or patients have to undergo a brief screening battery then surely this is preferable to the status quo.

3. Executive Functioning

While many subjects showed impaired performance on the Behavioural Assessment Of Dysexecutive Syndrome these deficits appeared to have little relationship to patients' psychosocial functioning whether rated by patients or relatives. This is particularly surprising when we consider that the Behaviour Change sub scale of the Questionnaires For S A H Patients and Relatives often taps everyday examples of dysexecutive functioning e.g. "Has the person become less tactful or well mannered?". Even more surprising perhaps is the lack of significant correlations between the B A D S and either patients' or relatives' D E X questionnaires. The D E X questionnaire according to Wilson (1996) is "constructed in order to sample the range of problems commonly associated with the Dysexecutive syndrome" (page 7) while the purpose of the B A D S "was to predict the presence and severity of everyday executive problems

among the brain injured" (page 18). Given the lack of significant correlations between these measures at least one of them cannot be measuring what it purports to measure.

The sub scores from the Modified Card Sorting Test were the best predictors of psychosocial functioning and quality of life of the measures of executive functioning employed in this study. That is, four out of seven (behaviour change, dependence, memory, and subjective) of the scales pertaining to relatives' ratings of psychosocial functioning were significantly correlated with either M C S T number of categories or M C S T percentage of perseverative errors at the 0.05 level of significance, although only one reached significance at the more stringent 0.01 level of significance adopted due to the large number of tests performed (the correlation between behavioural change and M C S T percentage of perseverative errors). Regarding relatives' ratings of quality of life all four sub-scales correlated modesty with M C S T percentage of perseverative errors (- 0.29 to - 0.34) reaching significance levels of 0.05 or below but failing to reach the more stringent 0.01 level of significance adopted.

No significant correlations were found between executive or cognitive functioning and patients' own ratings which may reflect poor validity in patients' self- ratings, although this is an issue we shall return to later. The results suggest a trend between poor performance on the M C S T, especially the number of perseverative errors and at least poor relatives' ratings of some aspects of psychosocial functioning (particularly behaviour change) and quality of life. This result largely replicates the findings of the one other study examining the relationship between executive and cognitive functioning and psychosocial functioning in which Vilkki et al (1990) found tests of cognitive inflexibility (which is primarily what the M C S T measures) to be the best

predictors of outcome on 5 psychosocial indices, G O S, work status, social relations, subjective mental status, and emotional status. Regarding work status in the present sample, there were no significant differences in either cognitive or executive functioning between those who returned to employment and those who didn't of those subjects who were working prior to their bleed. It should also be noted that there were no significant correlations between H A D S anxiety and depression and the scores on tests of executive and cognitive functioning employed in this study.

4. Acute Factors

Acute factors from around the time of the bleed were found to have some predictive power in relation to executive functioning and psychosocial functioning. Contrary to expectations older age at time of surgery was not related to poor outcome on any measure and, where some modest correlations were apparent, partial correlations revealed this to be due to the effects of age per se rather than older age at surgery contributing to poorer outcome. If anything, the results showed older patients to report somewhat higher quality of life and psychosocial functioning. These results may simply reflect the fact that this study had an upper cut off of 65 years and if older subjects had been included we would have seen different results. Alternatively these results may reflect a growing acceptance that perhaps severity of S A H, grade at operation, and the presence of delayed ischaemia are more important contributors to outcome than age (Stachniak et al 1996).

As hypothesized multivariate analysis showed no relationship between pre operative complications and cognitive or executive functioning although there was a significant

difference in patients with post operative complications, with a trend for patients with post operative complications to have poorer executive functions. These results concur with those of Richardson (1991) and Tidswell et al (1995) in finding post operative complications to be associated with some aspects of cognitive functioning. The measurement of post operative complications in the present study is crude and the numbers small. A larger study with subjects with more clearly defined post operative events would be necessary to explore in greater detail the relationship between different post operative events and different outcomes.

The results show no relationship between the presence of pre operative complications and any of the outcome measures concerning psychosocial functioning or quality of life while post operative complications were significantly associated with increased reports of psychosocial problems by patients but not relatives, and significantly higher HADS depression levels. On all other measures (patients' and relatives' quality of life, relatives' psychosocial functioning, and patients' and relatives' D E X) those with post operative complications showed poorer performance although in each case this failed to reach significance. These findings add further weight to those of Tidswell (1995) who found a significant correlation between post operative complications and a relatives' symptom checklist. Furthermore, these significant findings emphasise the need to minimise post operative complications, not only to decrease short term morbidity and mortality, but to improve long term outcome.

The last acute factor examined in the present study was the influence of aneurysm location. This showed that there were no significant differences on any of the outcome variables between those with non- anterior and anterior aneurysms. This result must be

treated with considerable caution for at least three reasons. Firstly, the numbers are small and as such only likely to detect large effects. Secondly, a far finer grained differentiation into exact location of bleed may be necessary to detect differences and the current practice of merely splitting subjects into anterior and non- anterior may be obscuring differences. Thirdly, if poorer outcomes are more likely among patients with anterior aneurysms then the current study which includes only good recoveries may be biased against such patients. The fact that only 8 subjects had anterior aneurysms and only 2 of these left anterior aneurysms suggests this may be occurring.

To conclude, of the acute factors considered in this study only post operative complications were found to be significantly correlated with late outcome. The importance of post operative complications are demonstrated by the fact that their presence is significantly correlated with a number of outcome measures including aspects of executive functioning, psychosocial functioning, and affective state. The exact nature of the relationship between the different post operative complications and these different aspects of late outcome remains to be clarified.

5. Self- Vs Others' Reports

No significant differences were found between patients' and relatives' reports on any measures - D E X, psychosocial functioning, and quality of life. This may reflect the fact that our current sample of S A H patients could accurately report their level of executive and psychosocial difficulties, and their quality of life. If this were the case, then we would not expect to find any differences between patients and relatives self-reports. In a similar vein, if patients' reports are valid and accurate we would expect

them to correlate significantly with more objective measures of impairment, such as cognitive and executive functioning. As we have already seen, there are no significant correlations between patients' subjective reports and these more objective measures of impairment even where the specificity between the measures is relatively high i.e. between the B A D S and the D E X questionnaires. There is some evidence of a modest association between relatives' reports and some aspect of executive functioning.

These results are somewhat at odds with the findings from studies of brain injured patients where patients often report lower levels of deficits in comparison to relatives. Two explanations may help make sense of the current findings. One possible explanation is that there are no significant differences between patients' and relatives' self- reports not because they are both accurate, but because they are both somewhat inaccurate. It has long been proposed that patients who suffer neurological damage under report deficits due to a lack of insight which is a direct result of their brain damage. The impact of other potential factors such as age and pre morbid personality have been largely ignored. In addition, relatives' reports tend to be seen as more accurate and objective although it has been found that they vary in relation to personality and levels of stress (McKinlay and Brooks 1984). The influence of gender on patients' and relatives' reports has largely been overlooked but may be a significant factor in previous findings and the present results. It has frequently been observed that women are more likely to acknowledge illness and admit to psychological symptoms than men which is often given as one reason for the higher ratio of women to men in community surveys of psychological disorders (e.g. 2.44:1 in the Bebbington et al 1981 survey). This idea has also received a degree of experimental support, for

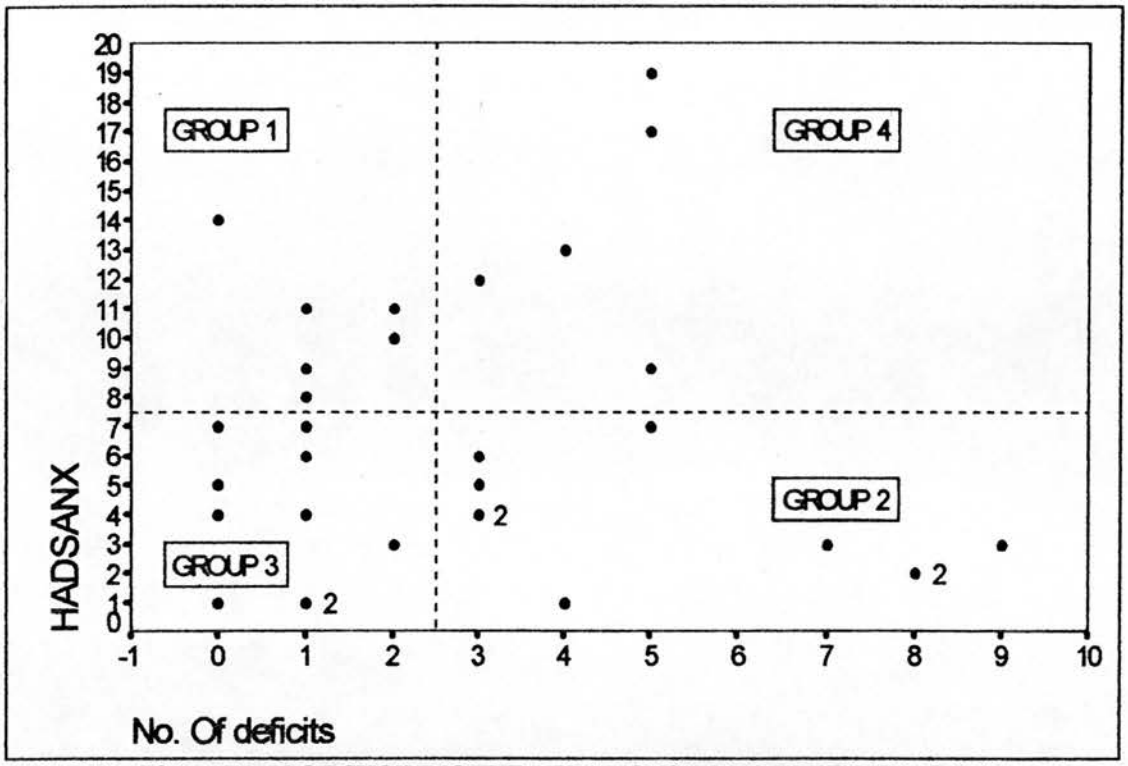
example, in a study by Angst & Dobler-Mikola (1984) males showed a greater tendency to forget symptoms.

In the traumatic brain injury literature where patients are predominantly young males and relatives responding often female (wives or mothers) there would be a tendency for this sex bias in responding to be exaggerated, especially if the male respondent do have some lack of insight. A difference between patients' and relatives' reports would therefore emerge. In the present study where 93.8% of subjects responding were female and 68.8% of relatives responding males, this would tend to obscures any differences between the groups if patients do show some lack of insight as this would minimise the bias in responding between the sexes. We would, therefore, expect patients' (mostly female) and relatives' (mostly male) ratings to converge. More work is required to test this hypothesis.

A second explanation is that within the present sample patients' and relatives' reports are accurate but fail to correlate with more objective measures of cognitive and executive functioning because, for many patients, cognitive and executive deficits are relatively unimportant in determining psychosocial outcome and quality of life. As I have already discussed the relationship between executive and cognitive deficits and psychosocial functioning and quality of life is at best modest and rather there is a far stronger association between emotional disorder and psychosocial functioning which we will go on to discuss in more detail. This position is partly supported by McKinlay and Brooks (1984) who conclude "the extent to which patients deny difficulties which relatives report as being present in the patient was not found to be related to cognitive deficits" (page 98).

6. HADS Anxiety And Depression And Their Relationship With Psychosocial Functioning And Quality Of Life

Results section 3.3 (page 74) clearly shows that while H A D S anxiety and depression are not correlated with executive of cognitive functioning they are highly correlated with many aspects of psychosocial functioning and quality of life. In addition, when we examine the result of the exploratory multiple regression analyses we, again, find that either H A D S anxiety or depression often independently account for the largest proportion of the variance explained in both patients' and relatives' reports of psychosocial functioning and quality of life. If we accept that relatives' report may be somewhat more accurate (although given the preceeding discussion such an assumption must be treated with considerable caution) then the multiple regression analyses would also appear to show executive functioning in terms of cognitive flexibility to be an important independent contributor to quality of life but nevertheless secondary to affective state. This suggests that while cognitive and executive deficits may have some direct impact on psychosocial functioning and quality of life for some patients affective state has considerably more.

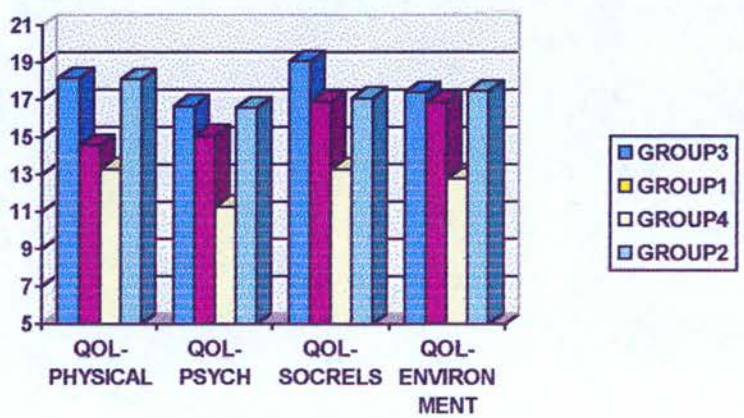


GRAPH 7 : SCATTER-PLOT SHOWING THE RELATIONSHIP BETWEEN HADS ANXIETY AND THE NUMBER OF SCORES IN THE BORDERLINE OR IMPAIRED RANGE.

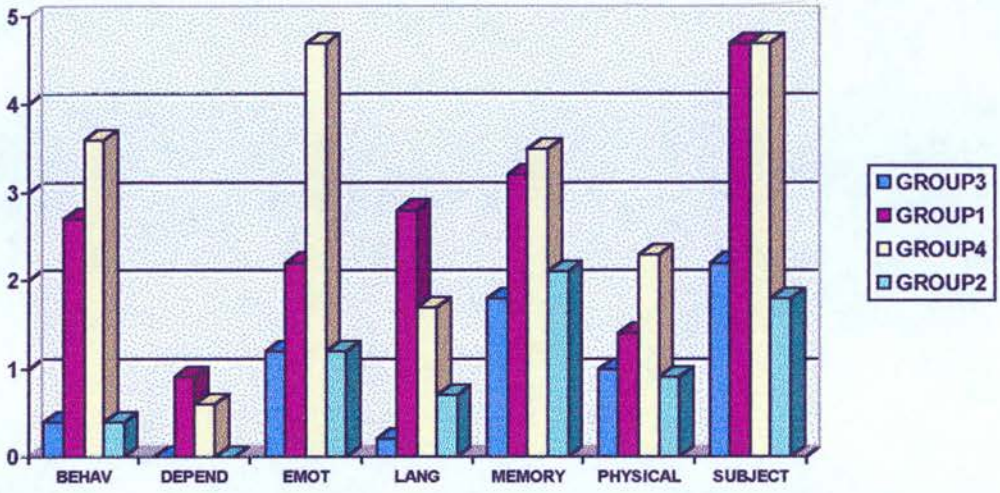
The scatter plot above shows the relationship between H A D S anxiety and number of cognitive or executive deficits in the borderline or impaired range. Hutter and Gilsbach (1995) reproduce a similar scatter plot charting depression and number of deficits which shows similar results. Two things are immediately clear, firstly, there is a group of patients who show no or only mild cognitive and executive deficits, but who have high levels of anxiety (Group 1). Conversely, there are also subjects with high numbers of deficit but little or no anxiety (Group 2). Using the cut off points as guides (ie a score greater than 7 on the HADS anxiety scale and more than 2 deficits in the borderline or impaired range) we are left with two additional groups. A relatively large group that shows no or mild cognitive and executive deficits, and only low levels of anxiety (Group 3), and a smaller group which displays both high levels of deficits and anxiety (Group 4). It may be worthwhile to describe these groups in more detail as they appear to vary on 2 important variables, that is, H A D S anxiety which we have

seen is highly correlated with psychosocial functioning and quality of life, and number of deficits which gives us some indication of level of objective impairment.

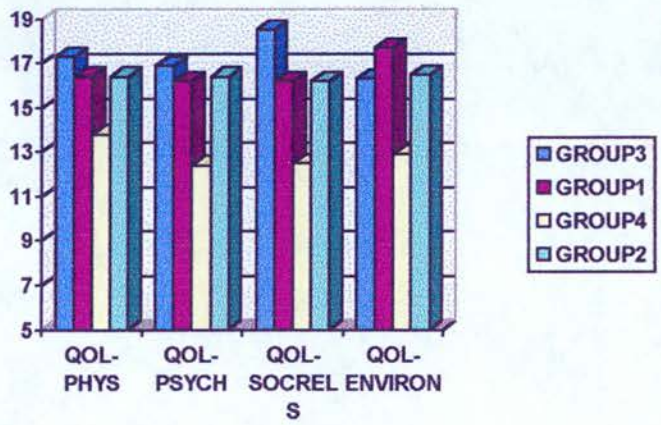
The mean scores of these groups on the outcome measures relating to psychosocial functioning, and quality of life are shown below (Graphs 8-11). The graphs show that the groups with neither anxiety or significant impairment (Group 3), significant anxiety but no or mild cognitive impairment (Group 1), and significant anxiety and impairments (Group 4) are behaving much as would be predicted from the results of the multiple regression analyses. That is, Group 3 with no significant affective or executive and cognitive impairment shows high levels of quality of life (Graphs 8&10) and relatively low scores concerning psychosocial difficulties (Graphs 9&11). Those with both cognitive or executive and affective impairment show the poorest performances on both measures (Graphs 8 to 11) . Group 1 who have only affective impairment lie between the extremes of these two groups. The most puzzling group is those with significant cognitive or executive impairment but no anxiety (Group 2). The patients' ratings for this group are often equivalent to those reported in the group with neither executive /cognitive or affective impairment (Group 3)- (See Graphs 8&9)



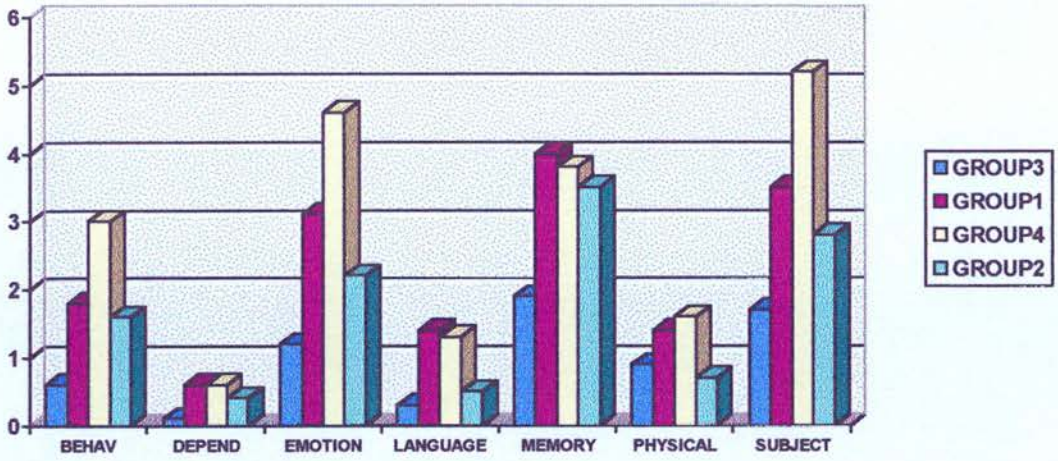
GRAPH 8 :COMPARISONS OF PATIENTS' REPORTS FOR THE 4 GROUPS FOR EACH OF THE QUALITY OF LIFE SUB-SCALES



GRAPH 9: COMPARISONS OF PATIENTS' REPORTS FOR THE 4 GROUPS ON EACH OF THE PSYCHOSOCIAL FUNCTIONING SUB-SCALES



GRAPH 10: COMPARISONS OF RELATIVES' REPORTS FOR THE 4 GROUPS FOR EACH OF THE QUALITY OF LIFE SUB-SCALES



GRAPH 11: COMPARISONS OF RELATIVES' REPORT FOR THE 4 GROUPS FOR EACH OF THE PSYCHOSOCIAL FUNCTIONING SUB-SCALES

The most attractive explanation would be that this group lacks insight into their deficits. When patients' and relatives' reports are compared for Group 2 there is a slight trend for relatives to report slightly lower quality of life and more psychosocial problems as well as higher D E X ratings although post hoc analysis showed none of these differences to be significant. Similarly, when we compare relatives' reports for Groups 2 and 3 there is again a trend towards relatives in the impaired group (Group 2) to report lower quality of life (See Graph 10) and more psychosocial difficulties (See Graph 11) although none of these differences reached significance in post hoc analysis. There is, therefore, a trend for subjects with cognitive or executive impairment but no affective impairment to underestimate their deficits in comparison to their relatives but this is not significant. Having said that, relatives' reports for this group still tend to be higher than for those of Groups 1 and 4. Are we therefore to conclude that Group 2, despite significant cognitive deficits, have made good recoveries in terms of psychosocial outcome and quality of life, or is it perhaps possible that relatives are also under estimating their deficits? Some reasons why there may be no differences in patients' and relatives' ratings in the present sample have already been discussed and are pertinent here. Further research is required to study this group to see whether

patients, despite in some cases having extensive cognitive or executive deficits, can continue to enjoy a good quality of life and psychosocial functioning as long as they don't have co-existing anxiety or depression.

I have already mentioned the model proposed by Moore and Stambrook (1995) (page 13) suggesting that the psychological consequences of traumatic brain injury may be important in moderating outcome, and I believe it may be helpful in interpreting the present results. Moore and Stambrook (1995) suggest that, in the early stages post brain injury patients experience a loss of control over many aspects of their lives, and many at least in the short term do not have the cognitive and problem solving capacities to reassert control. How patients react to this situation may have a substantial impact on their later psychosocial recovery and quality of life. If the patient accepts this externalisation of control, they are likely to experience a situation akin to learned helplessness where they come to expect negative outcomes, resulting in a lowering of their emotional state. Moore and Stambrook (1995) suggest that such a situation may give rise to sub optimal outcomes which may well begin to influence aspects of the patient's life unaffected by the injury. If this process is occurring in conjunction with ongoing cognitive and executive difficulties present in more severe injuries, these are likely to reinforce the individual's negative cognitive beliefs and in doing so, strengthen this negative cycle. This exacerbates the level of sub optimal outcome already present. Conversely, they suggest that the individual who views their cognitive difficulties as a challenge, or following the possibly life threatening event, come to appreciate what they have more fully are less likely to enter into this negative cycle and as such are more likely to reach optimal outcomes limited only by the extent of their cognitive and physical deficits.

Considering the analogous situation for S A H patients, it would appear that there is an equivalent, if not greater, loss of control with a number of subjects in the present study spontaneously expressing a belief that their bodies had 'betrayed' them. Virtually all S A H patients have to undergo an invasive neurosurgical procedure, which is not the case in T B I where more cases are managed conservatively. This is occurring in a milieu, at least in the short term, of marked impairment in executive and cognitive functioning (Ogden et al (1993) report almost 90 % of his sample showing impaired executive functioning in the immediate post operative period once post traumatic amnesia (PTA) had passed). Many patients worry that they have other aneurysms 'waiting to happen' and find reassurance difficult to accept, whilst for a number additional unruptured aneurysms are detected and the consequences of this, including prophylactic surgery must be considered. Additionally, the congenital defects implicated in many patients' aneurysms is another source of loss of control and concern with many frightened that their relatives or children may have these 'timebombs'. It would appear that in the immediate post operative period many of the factors suggested by Moore and Stambrook that result in poor psychological adjustment and negatives beliefs which pre-dispose the individual to a sub optimal outcome are present for the majority of S A H patients.

We can perhaps explain the 4 groups described earlier in terms of this model. Group 3 has no or mild cognitive and executive deficits and in addition makes a good psychological adjustment to what has happened which is perhaps to some extent aided by their lack of deficits. This group go on to do well and make what truly are good recoveries. Group 1, similarly, have little or no objective cognitive or executive

impairment but they have adjusted less well to what has happened to them leading to the negative expectations and sub optimal outcomes described by Moore and Stambrook. Despite little evidence of objective impairment, these patients come to view themselves as impaired which is perhaps exacerbated by their affective state as they may become hyper- sensitive to any even minor imperfections in their performance (e.g. Mogg et al 1993 demonstrated an increased sensitivity for negative information among anxious patients) which serves to reinforce their subjective experience. The consequences are that this group experience a reduction in psychosocial functioning and quality of life.

Group 4 is similar but, in addition, there is objective evidence of ongoing cognitive and executive deficits, which serve to further strengthen these individuals already negative beliefs and deepen the cycle resulting in an exaggerated sub optimal outcome. The final group, Group 2, is perhaps the most surprising as, despite their cognitive and executive deficits, their psychological adjustment is good (although for some with more severe executive deficits there may be merely at lack of insight). The result is that, although these individuals face some cognitive limitations, they are able to optimise their outcome to the extent that these limitations do not unduly affect their psychosocial functioning or quality of life. One could hypothesize that there comes a point where the severity of cognitive and executive difficulties makes this impossible but, for the present sample of largely women in their early fifties for whom life was reasonably stable and organised, and many of whom were employed in, perhaps, less demanding occupations that they had been doing for many years, it may well be that cognitive and executive deficits have to be relatively severe before they can impact directly on this reasonably settled lifestyle.

Moore and Stambrook provide some evidence in support of their model. For example in a study of 53 head injured men (Moore and Stambrook 1990) they found better outcome to be associated with self- controlling and positive reappraisal coping strategies and lower external locus of control. Lubusko, Moore, Stambrook, and Gill (1994) found negative cognitive beliefs (internal locus of control, higher powerful other's locus of control, and higher Beck Hopelessness Scale scores) to be associated with lower employment status among a group of 19 traumatically brain injured patients. Moore, Stambrook, and Wilson (1992) also demonstrated that locus of control beliefs accounted for significantly more variance in outcome than commonly used measures such as the Glasgow Coma Scale.

The main critique of Moore and Stambrook's model, the evidence they propose to support it, and the proposed relationship between negative cognitions and affective state and outcome in the current study is that evidence concerning direction of causality is largely lacking. Concerning the present study, it could be argued that it is not surprising that patients who have a lower quality of life and reduced psychosocial functioning are more anxious and depressed with anxiety and depression being caused by these changes to psychosocial functioning and quality of life. If this is the case, then what caused the poor psychosocial functioning and reduced quality of life as the available evidence would suggest that the relationship between these factors and more objective measures of severity and impairment (e.g. Glasgow Coma Scale, cognitive and executive functioning) are at best modest. It perhaps does seem likely then that negative beliefs and affective state are causally involved in poorer outcome, although the relationship is unlikely to be a simple one with pre-morbid factors, severity of

injury, presence of ongoing cognitive and executive deficits, and the psychosocial difficulties themselves combining and interacting to arrive at individual outcomes for individual patients.

The possible implications of a model where negative beliefs and affective state are causally and significantly related to outcome are potentially far reaching. That is, they suggest that, for considerable numbers of patients, expensive and time consuming cognitive rehabilitation may have less impact on outcome than brief psychological counselling. In addition, for those patients for whom cognitive rehabilitation is necessary, it is unlikely that the full benefits of this will be reaped unless psychological counselling is also provided. In relation to the present sample it may well be that improved quality of life and psychosocial functioning can be achieved in Group 1 and possibly also by Group 4 by the provision of brief psychotherapy early in the course of recovery to aid adjustment and challenge negative beliefs. This idea is still to be tested but presents an exciting possibility for future work.

7. Shortcomings Of Present Study

In a perfect world the current study would have had a significantly larger sample, an appropriate matched control, and would have been longitudinal rather than cross sectional perhaps examining a large group of at risk patients prior to their bleed and following up those who consequently suffered an S A H. Such an undertaking was well beyond the scope of the present study. Three principal shortcomings of the present study can perhaps be identified

(i) measures used

(ii) bias towards female subjects

(iii) wide range in time post bleed in the early group (5 to 22 months).

Regarding the measures employed in this study 2 unfortunately had no available normative data - the D E X questionnaires for patients and relatives and the'Questionnaire for S A H Patients' and 'Relatives'. The trend amongst researchers examining psychosocial consequences in neurological patients is to devise their own ad hoc questionnaires. The lack of a good standardised measure in this field is in general a serious short coming which limits comparisons between studies.

The fact that only 8.3 % of the current sample were male limits the generalisability of these results to populations with a more even spread of men and women. While women are over represented in S A H patients the ratio, is nothing like 11 :1 the figure in the current study. The current sample, however, does not appear to be totally misrepresentative of S A H patients treated in Tayside as, of the 109 patients originally identified as potential subjects in this study, only some 20 % were men. It is unclear why men at under represented among S A H patients operated on in Tayside.

It was the original intention to limit the early group to patients between 6 and 12 months post operation at time of assessment. Unfortunately, an expected source of subjects failed to materialise which resulted in these parameters having to be rather stretched to gain sufficient numbers. The consequence is perhaps more variation amongst this group than one might have hoped for.

8. Conclusions and Future Research

In conclusion, the present study has demonstrated that a significant proportion of SAH patients, despite being categorised as making 'good recoveries', have a range of cognitive and executive deficits that show no reduction over time. Many patients and their relatives, also report reduced psychosocial functioning and decreased quality of life. Although the accuracy of both patients' and relatives reports' is a matter of some doubt which requires further investigation. Whilst poor cognitive and executive functioning may have some direct impact on psychosocial functioning, for many patients affective state may be an important moderating factor, and for some affective state per se may have a direct impact on psychosocial functioning and quality of life. If this result is robust, it is hypothesised that many SAH patients could benefit from psychotherapy to help them maximise their outcome. The causal role of affective factors in outcome from SAH remains to be proven but given their possibly pivotal role and remediable nature this is an area of research which needs to be pursued.

The present study also highlighted flaws in the current follow-up system which leaves a proportion of patients with significant cognitive, executive and psychosocial deficits unsupported. In addition, it was found that post-operative complications were significantly related to poorer late outcome, whilst aneurysm location was unimportant. Both areas require to be pursued with larger samples to confirm these findings and explore in greater detail the relationship between type of complication and outcome. Finally, it is clear that the term 'good outcome' is a misleading one which potentially obscures a range of deficits and deflects attention away from the needs of this group of patients.

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APPENDIX 1: Questionnaires for Subjects

The Dysexecutive Questionnaire (DEX) - Self-Report

WHOQOL-BREF

Questionnaire for SAH Patients

BADS

Dex Questionnaire
Self-rating

Thames Valley Test Company

Subject's name

Date

This questionnaire looks at some of the difficulties that people sometimes experience. We would like you to read the following statements, and rate them on a five-point scale according to your own experience:

1 I have problems understanding what other people mean unless they keep things simple and straightforward

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

2 I act without thinking, doing the first thing that comes to mind

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

3 I sometimes talk about events or details that never actually happened, but I believe did happen

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

4 I have difficulty thinking ahead or planning for the future

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

5 I sometimes get over-excited about things and can be a bit 'over the top' at these times

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

6 I get events mixed up with each other, and get confused about the correct order of events

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

7 I have difficulty realizing the extent of my problems and am unrealistic about the future

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

8 I am lethargic, or unenthusiastic about things

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

9 I do or say embarrassing things when in the company of others

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

10 I really want to do something one minute, but couldn't care less about it the next

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

11 I have difficulty showing emotion

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

12 I lose my temper at the slightest thing

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

13 I am unconcerned about how I should behave in certain situations

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

14 I find it hard to stop repeating saying or doing things once they've started

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

15 I tend to be very restless, and 'can't sit still' for any length of time

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

16 I find it difficult to stop myself from doing something even if I know I shouldn't

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

17 I will say one thing, but will do something different

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

18 I find it difficult to keep my mind on something, and am easily distracted

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

19 I have trouble making decisions, or deciding what I want to do

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

20 I am unaware of, or unconcerned about, how others feel about my behaviour

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

 BADS, ISBN 1 874261 95 4

Thames Valley Test Company, 7–9 The Green, Flempton, Bury St Edmunds, Suffolk, IP28 6EL, England.

WHOQOL-BREF

Field Trial Version
December 1996

PROGRAMME ON MENTAL HEALTH

WORLD HEALTH ORGANISATION, GENEVA

For office use only

	Equations for computing domain scores	Raw score	Transformed scores*	
			4-20	0-100
Domain 1	(6-Q3) + (6-Q4) + Q10 + Q15 + Q16 + Q17 + Q18 ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		
Domain 2	Q5 + Q6 + Q7 + Q11 + Q19 + (6-Q26) ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		
Domain 3	Q20 + Q21 + Q22 ☐ + ☐ + ☐	=		
Domain 4	Q8 + Q9 + Q12 + Q13 + Q14 + Q23 + Q24 + Q25 ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		

* Please see Table 4 on page 9 of the manual, for converting raw scores to transformed scores.

ABOUT YOU

I.D. number ☐☐☐☐

efore you begin we would like to ask you to answer a few general questions about yourself: by circling the orrect answer or by filling in the space provided.

/hat is your **gender**? Male Female

/hat is you **date of birth**? _____ / _____ / _____
Day / Month / Year

/hat is the highest **education** you received? None at all
Primary school
Secondary school
Tertiary

/hat is your **marital status**? Single Separated
Married Divorced
Living as married Widowed

re you currently **ill**? Yes No

something is wrong with your health what do you think it is?_____illness/
roblem

nstructions

his assessment asks how you feel about your quality of life, health, or other areas of your life. **Please answer ll the questions.** If you are unsure about which response to give to a question, **please choose the one** that ppears most appropriate. This can often be your first response.

lease keep in mind your standards, hopes, pleasures and concerns. We ask that you think about your life **in ne last two weeks.** For example, thinking about the last two weeks, a question might ask:

		Not at all	Not much	Moderately	A great deal	Completely
	Do you get the kind of support from others that you need?	1	2	3	4	5

ou should circle the number that best fits how much support you got from others over the last two weeks. So ou would circle the number 4 if you got a great deal of support from others as follows.

		Not at all	Not much	Moderately	A great deal	Completely
	Do you get the kind of support from others that you need?	1	2	3	(4)	5

ou would circle number 1 if you did not get any of the support that you needed from others in the last two eeks. Please read each question, assess your feelings, and circle the number on the scale for each question that ves the best answer for you.

		Very poor	Poor	Neither poor nor good	Good	Very good
(G1)	How would you rate your quality of life?	1	2	3	4	5

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
(G4)	How satisfied are you with your health?	1	2	3	4	5

The following questions ask about **how much** you have experienced certain things in the last two weeks.

		Not at all	A little	A moderate amount	Very much	An extreme amount
?1.4)	To what extent do you feel that (physical) pain prevents you from doing what you need to do?	1	2	3	4	5
?11.3)	How much do you need any medical treatment to function in your daily life?	1	2	3	4	5
?4.1)	How much do you enjoy life?	1	2	3	4	5
?24.2)	To what extent do you feel your life to be meaningful?	1	2	3	4	5

		Not at all	A little	A moderate amount	Very much	Extremely
?5.3)	How well are you able to concentrate?	1	2	3	4	5
?16.1)	How safe do you feel in your daily life?	1	2	3	4	5
?22.1)	How healthy is your physical environment?	1	2	3	4	5

The following questions ask about **how completely** you experience or were able to do certain things in the last two weeks.

		Not at all	A little	Moderately	Mostly	Completely
0 ?2.1)	Do you have enough energy for everyday life?	1	2	3	4	5
1 ?7.1)	Are you able to accept your bodily appearance?	1	2	3	4	5
2 ?18.1)	Have you enough money to meet your needs?	1	2	3	4	5
3 ?20.1)	How available to you is the information that you need in your day-to-day life?	1	2	3	4	5
4 ?21.1)	To what extent do you have the opportunity for leisure activities?	1	2	3	4	5

		Very poor	Poor	Neither poor nor good	Good	Very good
9.1)	How well are you able to get around?	1	2	3	4	5

ne following questions ask you to say how **good or satisfied** you have felt about various aspects of your life ver the last two weeks.

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
3.3)	How satisfied are you with your sleep?	1	2	3	4	5
10.3)	How satisfied are you with your ability to perform your daily living activities?	1	2	3	4	5
12.4)	How satisfied are you with your capacity for work?	1	2	3	4	5
6.3)	How satisfied are you with yourself?	1	2	3	4	5
13.3)	How satisfied are you with your personal relationships?	1	2	3	4	5
15.3)	How satisfied are you with your sex life?	1	2	3	4	5
14.4)	How satisfied are you with the support you get from your friends?	1	2	3	4	5
17.3)	How satisfied are you with the conditions of your living place?	1	2	3	4	5
19.3)	How satisfied are you with your access to health services?	1	2	3	4	5
23.3)	How satisfied are you with your transport?	1	2	3	4	5

he following question refers to **how often** you have felt or experienced certain things in the last two weeks.

		Never	Seldom	Quite often	Very often	Always
8.1)	How often do you have negative feelings such as blue mood, despair, anxiety, depression?	1	2	3	4	5

id someone help you to fill out this form?.....
How long did it take to fill this form out?.....

Do you have any comments about the assessment?

.....
.....
.....

THANK YOU FOR YOUR HELP

Questionnaire For SAH Patients.

We are trying to find out more about the possible difficulties people may experience in a range of situations throughout their life after they have suffered a sub-arachnoid haemorrhage. It would therefore be helpful if you would fill in this questionnaire.

1. Name _____

2. Today's Date_____

The questions which follow are about your health over the last few weeks, compared with your health before the aneurysm.

DO YOU SUFFER FROM:

(For each question circle the answer which applies)

3. POOR VISION	no change	rather worse since the aneurysm	much worse since the aneurysm
4. POOR HEARING	no change	rather worse since the aneurysm	much worse since the aneurysm
5. POOR SENSE OF TASTE	no change	rather worse since the aneurysm	much worse since the aneurysm
6. POOR SENSE OF SMELL	no change	rather worse since the aneurysm	much worse since the aneurysm
7. POOR BALANCE	no change	rather worse since the aneurysm	much worse since the aneurysm
8. DIZZY SPELLS	no change	rather worse since the aneurysm	much worse since the aneurysm
9. HEADEACHES	no change	rather worse since the aneurysm	much worse since the aneurysm
10. TIREDNESS	no change	rather worse since the aneurysm	much worse since the aneurysm
11. DIFFICULTY SLEEPING OR DISTURBED SLEEP	no change	rather worse since the aneurysm	much worse since the aneurysm
12. SLOWNESS	no change	rather worse since the aneurysm	much worse since the aneurysm
13. TENSION OR ANXIETY	no change	rather worse	much worse

		since the aneurysm	since the aneurysm
14. IMPATIENCE	no change	rather worse since the aneurysm	much worse since the aneurysm
15. FIND NOISE DISTRESSING	no change	rather worse since the aneurysm	much worse since the aneurysm
16. IRRITABILITY	no change	rather worse since the aneurysm	much worse since the aneurysm
17. OUTBURSTS OF TEMPER	no change	rather worse since the aneurysm	much worse since the aneurysm
18. OUTBURSTS OF VIOLENCE	no change	rather worse since the aneurysm	much worse since the aneurysm
19. DIFFICULTY SPEAKING e.g. slurred speech, stammer.	no change	rather worse since the aneurysm	much worse since the aneurysm
20. DIFFICULTY FINDING THE RIGHT WORD	no change	rather worse since the aneurysm	much worse since the aneurysm
21. DIFFICULTY UNDER-STANDING WHAT WORDS MEAN- <u>not</u> due to poor hearing	no change	rather worse since the aneurysm	much worse since the aneurysm
22. POOR CONCENTRATION	no change	rather worse since the aneurysm	much worse since the aneurysm
23. DEPRESSION	no change	rather worse since the aneurysm	much worse since the aneurysm
24. CHILDISHNESS	no change	rather worse since the aneurysm	much worse since the aneurysm
25. SUDDEN CHANGES IN MOOD	no change	rather worse since the aneurysm	much worse since the aneurysm

(Please tick one answer to each question)

26. Has your personality changed as a result of the aneurysm?

No ☐ Yes ☐

27. Have you become more passive, 'not bothered' or have you less drive?

No ☐ To some extent ☐ Very much so ☐

28. Is your memory worse than before the aneurysm?

No ☐ Rather Worse ☐ Much worse ☐

29. If your memory is worse, please answer these questions by ticking 'yes' or 'no'.

Do you forget the name of acquaintances?	Yes ☐	No ☐
Do you mislay things?	Yes ☐	No ☐
Do you fail to recognise faces or places?	Yes ☐	No ☐
Do you forget things other people tell you?	Yes ☐	No ☐
Do you forget what day it is?	Yes ☐	No ☐
Do you get lost if out alone?	Yes ☐	No ☐

30. Have you suffered any fits/seizures since discharge from hospital?

None ☐ Occasional ☐ Regular ☐

31. Do you need to take tablets to prevent fits/ seizures?

No ☐ Yes ☐

32. As a result of the aneurysm, are you disabled to the extent that stick, crutches, wheelchair, etc., are needed to get about BY YOURSELF? (Tick one answer only)

Fully independent, that is, no aids and no difficulty getting about ☐

Get about without aids but with some difficulty ☐

Need stick/crutch ☐

Confined to wheelchair, can move self in it ☐

Confined to wheelchair, need pushed ☐

Confined to bed ☐

33. Has your sex life changed since the aneurysm?

Not adversely affected ☐ Adversely affected ☐ Don't know ☐

34. Are you independent in self care (washing, dressing, toileting)?

No change due to injury ☐ Need more help ☐ Need a lot more help ☐

35. Do you need supervision outdoors?

No change due to injury ☐ Need more help ☐ Need a lot more help ☐

36. Do you need supervision indoors?

No change due to injury ☐ Need more help ☐ Need a lot more help ☐

37. Are you attending any out-patient clinics?

Yes ☐ No ☐

If "Yes", please specify_____

38. What is the your NORMAL line of employment?

Please state_____

39. Just before the aneurysm, what was the your work status? (tick one)

Working full time ☐ Working part time ☐ Housewife ☐

Student ☐ Retired ☐ Unemployed ☐ Unfit for work ☐

40. Please describe briefly your present occupation (if any).

Please state_____

41. At the present time, what is your work status?

Working full time ☐ Working part time ☐ Housewife ☐

Student ☐ Retired ☐ Unemployed ☐ Unfit for work ☐

42. Do you think your future employment prospects have been affected by the aneurysm?

Not affected ☐ Affected to some extent ☐ Very much worse ☐

43. Has your leisure and social life changed since the aneurysm?

Little or no change ☐ Rather worse ☐ Much worse ☐

44. How much strain do you think your husband/wife/partner has been under as a result of the aneurysm?

Please tick somewhere from 0 = no strain to 10 = severe strain:

0 1 2 3 4 5 6 7 8 9 10

No strain Severe strain

45. Have you become less sociable since the aneurysm?

No change ☐ A bit less ☐ Much less ☐

46. Have you been more outgoing or friendly since the aneurysm?

No change ☐ A bit more ☐ Much more ☐

47. Have you been less tactful or well mannered since the aneurysm?

No change ☐ A bit less ☐ Much less ☐

48. Has your behaviour changed for the worse since the aneurysm?

No change ☐ A bit worse ☐ Much worse ☐

49. Have you been looking after yourself - keeping clean and tidy?

No change ☐ Less care ☐ Much less ☐

50. Compared to before the aneurysm, do you take an active part in household tasks?

No change ☐ Less ☐ Much less ☐

51. Do you play the same part in making decisions as before?

No change ☐ Less ☐ Much less ☐

52. Do you chat to your partner/relatives about everyday things (news, local events, and people) and take an interest in what they are doing?

No change ☐ Less ☐ Much less ☐

53. Has your partner/relatives been able to discuss problems or worries with you since the aneurysm?

No change ☐ Less ☐ Much less ☐

54. Are you as warm and affectionate to your partner/relatives since the aneurysm?

No change ☐ Less ☐ Much less ☐
(or more)

55. If you have a husband, wife or partner, compared to before the aneurysm, have you been as interested in your sexual relationship and their responses and enjoyment?

No change ☐ Less ☐ Much less ☐

56. If you have children, have you been taking the same interest in the children as before the aneurysm?

No change ☐ Less ☐ Much less ☐

THANKYOU FOR YOUR COOPERATION

APPENDIX 2 - Questionnaires for Relatives

Dysexecutive Questionnaire (DEX) - Independent Rater

WHOQOL-BREF: Relative's Version

Questionnaire for Relatives

Thames Valley Test Company

Dex Questionnaire
Independent rater

Subject's name

Date of rating

Rater's name

Relationship to subject

This questionnaire looks at some of the difficulties that people sometimes experience. We would like you to read the following statements, and rate them on a five-point scale according to your experience of _____ [the subject]:

1 Has problems understanding what other people mean unless they keep things simple and straightforward

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

2 Acts without thinking, doing the first thing that comes to mind

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

3 Sometimes talks about events or details that never actually happened, but s/he believes did happen

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

4 Has difficulty thinking ahead or planning for the future

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

5 Sometimes gets over-excited about things and can be a bit 'over the top' at these times

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

6 Gets events mixed up with each other, and gets confused about the correct order of events

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

7 Has difficulty realizing the extent of his/her problems and is unrealistic about the future

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

8 Seems lethargic, or unenthusiastic about things

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

9 Does or says embarrassing things when in the company of others

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

10 Really wants to do something one minute, but couldn't care less about it the next

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

11 Has difficulty showing emotion

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

12 Loses his/her temper at the slightest thing

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

13 Seems unconcerned about how s/he should behave in certain situations

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

14 Finds it hard to stop repeating saying or doing things once started

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

15 Tends to be very restless, and 'can't sit still' for any length of time

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

16 Finds it difficult to stop doing something even if s/he knows s/he shouldn't

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

17 Will say one thing, but will do something different

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

18 Finds it difficult to keep his/her mind on something, and is easily distracted

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

19 Has trouble making decisions, or deciding what s/he wants to do

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

20 Is unaware of, or unconcerned about, how others feel about his/her behaviour

☐0 ☐1 ☐2 ☐3 ☐4

Never Occasionally Sometimes Fairly often Very often

 BADS, ISBN 1 874261 95 4.
Thames Valley Test Company, 7–9 The Green, Flempton, Bury St Edmunds, Suffolk, IP28 6EL, England.

WHOQOL-BREF

Field Trial Version
December 1996
Relatives Version

PROGRAMME ON MENTAL HEALTH

WORLD HEALTH ORGANISATION, GENEVA

For office use only

	Equations for computing domain scores	Raw score	Transformed scores*	
			4-20	0-100
Domain 1	(6-Q3) + (6-Q4) + Q10 + Q15 + Q16 + Q17 + Q18 ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		
Domain 2	Q5 + Q6 + Q7 + Q11 + Q19 + (6-Q26) ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		
Domain 3	Q20 + Q21 + Q22 ☐ + ☐ + ☐	=		
Domain 4	Q8 + Q9 + Q12 + Q13 + Q14 + Q23 + Q24 + Q25 ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐ + ☐	=		

* Please see Table 4 on page 9 of the manual, for converting raw scores to transformed scores.

ABOUT YOUR RELATIVE

I.D. number ☐☐☐☐

Before you begin we would like to ask you to answer a few general questions about your relative: by circling the correct answer or by filling in the space provided.

What is their **gender**? Male Female

What is their **date of birth**? _____ / _____ / _____
Day / Month / Year

What is the highest **education** they received? None at all
Primary school
Secondary school
Tertiary

What is their **marital status**? Single Separated
Married Divorced
Living as married Widowed

Is your relative currently **ill**? Yes No

If something is wrong with your relative's health what do you think it is?_____illness/ problem

Instructions

This assessment asks how you feel about your relative's quality of life, health, or other areas of their life. **Please answer all the questions.** If you are unsure about which response to give to a question, **please choose the one** that appears most appropriate. This can often be your first response.

Please keep in mind what you feel to be your relative's standards, hopes, pleasures and concerns. We ask that you think about their life **in the last two weeks.** For example, thinking about the last two weeks, a question might ask:

		Not at all	Not much	Moderately	A great deal	Completely
	Does your relative get the kind of support from others that they need?	1	2	3	4	5

You should circle the number that best fits how much support you feel that your relative got from others over the last two weeks. So you would circle the number 4 if they got a great deal of support from others as follows.

		Not at all	Not much	Moderately	A great deal	Completely
	Does your relative get the kind of support from others that they need?	1	2	3	(4)	5

You would circle number 1 if they did not get any of the support that they needed from others in the last two weeks. Please read each question, assess your feelings, and circle the number on the scale for each question that gives the best answer for your relative.

		Very poor	Poor	Neither poor nor good	Good	Very good
(G1)	How would you rate your relative's quality of life?	1	2	3	4	5

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
(G4)	How satisfied are you with your relative's health?	1	2	3	4	5

The following questions ask about **how much** your relative has experienced certain things in the last two weeks.

		Not at all	A little	A moderate amount	Very much	An extreme amount
1.4)	To what extent do you feel that (physical) pain prevents your relative from doing what they need to do?	1	2	3	4	5
11.3)	How much does your relative need any medical treatment to function in their daily life?	1	2	3	4	5
4.1)	How much does your relative enjoy life?	1	2	3	4	5
24.2)	To what extent do you feel their life to be meaningful?	1	2	3	4	5

		Not at all	A little	A moderate amount	Very much	Extremely
5.3)	How well are they able to concentrate?	1	2	3	4	5
16.1)	How safe does your relative feel in their daily life?	1	2	3	4	5
22.1)	How healthy is their physical environment?	1	2	3	4	5

The following questions ask about **how completely** your relative experiences or was able to do certain things in the last two weeks.

		Not at all	A little	Moderately	Mostly	Completely
2.1)	Does your have enough energy for everyday life?	1	2	3	4	5
7.1)	Is your relative able to accept their bodily appearance?	1	2	3	4	5
18.1)	Has your relative enough money to meet their needs?	1	2	3	4	5
20.1)	How available to your relative is the information that they need in their day-to-day life?	1	2	3	4	5
21.1)	To what extent does your relative have the opportunity for leisure activities?	1	2	3	4	5

		Very poor	Poor	Neither poor nor good	Good	Very good
9.1)	How well is your relative able to get around?	1	2	3	4	5

The following questions ask you to say how **good or satisfied** you have felt about various aspects of your relative's life over the last two weeks.

		Very dissatisfied	Dissatisfied	Neither satisfied nor dissatisfied	Satisfied	Very satisfied
5 (3.3)	How satisfied are you with your relative's sleep?	1	2	3	4	5
7 (10.3)	How satisfied are you with your relative's ability to perform your daily living activities?	1	2	3	4	5
8 (12.4)	How satisfied are you with your relative's capacity for work?	1	2	3	4	5
9 (6.3)	How satisfied are you with your relative?	1	2	3	4	5
0 (13.3)	How satisfied is your relative with their personal relationships?	1	2	3	4	5
1 (15.3)	How satisfied is your relative with their sex life?	1	2	3	4	5
2 (14.4)	How satisfied are you with the support your relative gets from their friends?	1	2	3	4	5
3 (17.3)	How satisfied are you with the conditions of your relative's living place?	1	2	3	4	5
4 (19.3)	How satisfied are you with your relative's access to health services?	1	2	3	4	5
5 (23.3)	How satisfied are you with your relative's transport?	1	2	3	4	5

The following question refers to **how often** your relative has felt or experienced certain things in the last two weeks.

		Never	Seldom	Quite often	Very often	Always
6 (8.1)	How often does your relative have negative feelings such as blue mood, despair, anxiety, depression?	1	2	3	4	5

Did someone help you to fill out this form?.....

How long did it take to fill this form out?.....

Do you have any comments about the questionnaire?

.....

.....

THANK YOU FOR YOUR HELP

Questionnaire For Relatives.

As well as interviewing and assessing the person who had an aneurysm, we have found it helpful to ask a relative or close friend how the person is progressing. This helps to make sure we don't miss symptoms or changes resulting from the aneurysm.

It would therefore be helpful if you would fill in this questionnaire.

1. Name of person/patient_____

2. Today's Date_____

3. Your own name_____

4. How are you related to the person who had an aneurysm?

The person is my...(tick one)

Husband Wife Child Parent Brother Sister

If none of these, please state relationship_____

5. Who is the main person, if anybody, who looks after the person who had an aneurysm?

_____

The questions which follow are about the person who had an aneurysms health over <u>the last few weeks,</u> compared with his/her health before the aneurysm.

DOES THE PERSON SUFFER FROM:

(For each question circle the answer which applies)

6. POOR VISION	no change	rather worse since the aneurysm	much worse since the aneurysm
7. POOR HEARING	no change	rather worse since the aneurysm	much worse since the aneurysm
8. POOR SENSE OF TASTE	no change	rather worse since the aneurysm	much worse since the aneurysm
9. POOR SENSE OF SMELL	no change	rather worse since the aneurysm	much worse since the aneurysm
10. POOR BALANCE	no change	rather worse since the aneurysm	much worse since the aneurysm

11. DIZZY SPELLS	no change	rather worse since the aneurysm	much worse since the aneurysm
12. HEADEACHES	no change	rather worse since the aneurysm	much worse since the aneurysm
13. TIREDNESS	no change	rather worse since the aneurysm	much worse since the aneurysm
14. DIFFICULTY SLEEPING OR DISTURBED SLEEP	no change	rather worse since the aneurysm	much worse since the aneurysm
15. SLOWNESS	no change	rather worse since the aneurysm	much worse since the aneurysm
16. TENSION OR ANXIETY	no change	rather worse since the aneurysm	much worse since the aneurysm
17. IMPATIENCE	no change	rather worse since the aneurysm	much worse since the aneurysm
18. FINDS NOISE DISTRESSING	no change	rather worse since the aneurysm	much worse since the aneurysm
19. IRRITABILITY	no change	rather worse since the aneurysm	much worse since the aneurysm
20. OUTBURSTS OF TEMPER	no change	rather worse since the aneurysm	much worse since the aneurysm
21. OUTBURSTS OF VIOLENCE	no change	rather worse since the aneurysm	much worse since the aneurysm
22. DIFFICULTY SPEAKING e.g. slurred speech, stammer.	no change	rather worse since the aneurysm	much worse since the aneurysm
23.DIFFICULTY FINDING THE RIGHT WORD	no change	rather worse since the aneurysm	much worse since the aneurysm
24. DIFFICULTY UNDER-STANDING WHAT WORDS MEAN- not due to poor hearing	no change	rather worse since the aneurysm	much worse since the aneurysm
25. POOR CONCENTRATION	no change	rather worse since the aneurysm	much worse since the aneurysm
26. DEPRESSION	no change	rather worse since the aneurysm	much worse since the aneurysm
27. CHILDISHNESS	no change	rather worse since the aneurysm	much worse since the aneurysm

28. SUDDEN CHANGES IN MOOD	no change	rather worse since the aneurysm	much worse since the aneurysm

(Please tick one answer to each question)

29. Has the person's personality changed as a result of the aneurysm?

No ☐ Yes ☐

30. Has the person become more passive, 'not bothered' or has he/she less drive?

No ☐ To some extent ☐ Very much so ☐

31. Is the person's memory worse than before the aneurysm?

No ☐ Rather Worse ☐ Much worse ☐

32. If the person's memory is worse, please answer these questions by ticking 'yes' or 'no'.

Does he/she forget the name of acquaintances	Yes ☐	No ☐
Does he/she mislay things?	Yes ☐	No ☐
Does he/she fail to recognise faces or places?	Yes ☐	No ☐
Does he/she forget things you tell them?	Yes ☐	No ☐
Does he/she forget what day it is?	Yes ☐	No ☐
Does he/she get lost if out alone?	Yes ☐	No ☐

33. Has the person suffered any fits/seizures since discharge from hospital?

None ☐ Occasional ☐ Regular ☐

34. Does he/she need to take tablets to prevent fits/ seizures?

No ☐ Yes ☐

35. As a result of the aneurysm, is he/she disabled to the extent that stick, crutches, wheelchair, etc., are needed to get about BY THEMSELVES? (Tick one answer only)

Fully independent, that is, no aids and no difficulty getting about ☐

Gets about without aids but with some difficulty ☐

Needs stick/crutch ☐

Confined to wheelchair, can move self in it ☐

Confined to wheelchair, needs pushed ☐

Confined to bed ☐

36. Has the person's sex life changed since the aneurysm

Not adversely affected ☐ Adversely affected ☐ Don't know ☐

37. Is the person independent in self care (washing, dressing, toileting)?

No change due to injury ☐ Needs more help ☐ Needs a lot more help ☐

38. Does the person need supervision outdoors?

No change due to injury ☐ Needs more help ☐ Needs a lot more help ☐

39. Does the person need supervision indoors?

No change due to injury ☐ Needs more help ☐ Needs a lot more help ☐

40. Is the person attending any out-patient clinics?

Yes ☐ No ☐

If "Yes", please specify_____

41. What is the person's NORMAL line of employment?

Please state_____

42. Just before the aneurysm, what was the person's work status? (tick one)

Working full time ☐ Working part time ☐ Housewife ☐

Student ☐ Retired ☐ Unemployed ☐ Unfit for work ☐

43. Please describe briefly his/her present occupation (if any).

Please state_____

44. At the present time, what is the person's work status?

Working full time ☐ Working part time ☐ Housewife ☐

Student ☐ Retired ☐ Unemployed ☐ Unfit for work ☐

45. Do you think his/her future employment prospects have been affected by the aneurysm?

Not affected ☐ Affected to some extent ☐ Very much worse ☐

46. Has the person's leisure and social life changed since the aneurysm?

Little or no change ☐ Rather worse ☐ Much worse ☐

47. How much strain have *you yourself* been under as a result of the aneurysm?

Please tick somewhere from 0 = no strain to 10 = severe strain:

0 1 2 3 4 5 6 7 8 9 10

No strain Severe strain

48. Has he/she become less sociable since the aneurysm?

No change ☐ A bit less ☐ Much less ☐

49. Has the person been more outgoing or friendly since the aneurysm?

No change ☐ A bit more ☐ Much more ☐

50. Has the person been less tactful or well mannered since the aneurysm?

No change ☐ A bit less ☐ Much less ☐

51. Has his/her behaviour changed for the worse since the aneurysm?

No change ☐ A bit worse ☐ Much worse ☐

52. Has the person been looking after him/herself - keeping clean and tidy?

No change ☐ Less care ☐ Much less ☐

53. Compared to before the aneurysm, does the person take an active part in household tasks?

No change ☐ Less ☐ Much less ☐

54. Does he/she play the same part in making decisions as before?

No change ☐ Less ☐ Much less ☐

55. Does he/she chat to you about everyday things (news, local events, and people) and take an interest in what you are doing?

No change ☐ Less ☐ Much less ☐

56. Have you been able to discuss problems or worries with the person since the aneurysm?

No change ☐ Less ☐ Much less ☐

57. Is he/she as warm and affectionate to you since the aneurysm?

No change ☐ Less ☐ Much less ☐
(or more)

58. If the person is your husband, wife or partner, compared to before the aneurysm, has he/she been as interested in your sexual relationship and your responses and enjoyment?

No change ☐ Less ☐ Much less ☐

59. If he/she has children, has he/she been taking the same interest in the children as before the aneurysm?

No change ☐ Less ☐ Much less ☐

THANKYOU FOR YOUR COOPERATION

APPENDIX 3 - Glasgow Outcome Scale (GOS)

THE GLASGOW OUTCOME SCALE

This scale classifies global outcome on a 5 point scale on which the lowest level is death, and the highest is good recovery. The descriptions and operational criteria for the different levels are as follows

Good Recovery

Resumption of normal life, even though there may be minor neurological or psychological deficits. Return to work is unrealistic as a main criterion of outcome, because it may lead to unrealistic expectations, and is very sensitive to local economic and cultural situations. Furthermore, some patients with considerable disability may be fully employed, either because of modifications of the workplace, a job which is compatible with a particular disability, or because an employer is being generous in providing what is effectively, sheltered employment. Other aspects of social outcome should be included in the assessment here, such as leisure activities, and family relationships.

Moderate Disability (disabled but independent)

Such patients can travel by public transport and can work in a sheltered environment, and are therefore independent as far as daily life is concerned. The disabilities found include varying degrees of dysphasia, hemipareses, or ataxia, as well as intellectual and memory deficits, and personality and emotional/behavioural change. These may produce considerable family disruption.

Severe Disability (conscious but disabled)

These patients are dependent upon others for daily support by reason of mental or physical disability (usually both). They could not get through a 24 hour period without help from others. Many may be in long term care in a residential facility, but this should not be a criterion for scoring disability at this level, as exceptional family efforts may enable such people to be cared for at home. It is important to be aware that severe mental disability may justify this classification in a patient who has little or no physical disability.

APPENDIX 4 - Correspondence with GPs and Subjects

Letter to GPs

Letter to Subjects

Information Sheet provided to GPs and Subjects

Dundee Healthcare
NHS TRUST

Alan Harper
Department of Clinical Psychology
Dundee Royal Infirmary
Dundee.

Tel. 346679.

Dear

I am writing to you about a research project that is currently taking place at Dundee Royal Infirmary. Our records show that you are a former patient of the Neurosurgical Unit at DRI where you were a patient in

I would be grateful if you would consider taking part in this study. I have enclosed an Information Sheet that may answer some of the questions you have, and I would be happy to answer any further questions if you contact me at the above number. In addition, unless you have any objections I will contact you in a few days time to answer any queries you might have about this study, and arrange a suitable time and date should you wish to take part.

Yours sincerely,

Alan Harper,
Psychologist.

INFORMATION SHEET

A cross-sectional study of executive functioning and quality of life after sub-arachnoid haemorrhage.

This is an information sheet about a research study called "A cross-sectional study of executive functioning and quality of life after sub-arachnoid haemorrhage". Cross-sectional refers to the fact that we wish to look at different groups of patients at different lengths of time after their aneurysm, and executive functioning means peoples abilities to plan, organise, and set goals, etc.. We would be grateful if you could read this sheet and decide whether or not you would like to take part. One of us will discuss the research study with you and answer any questions you might have.

Why is the study being done?

Many people now survive sub-arachnoid haemorrhages (SAH) and go on to make a reasonable or good recovery. That is, they experience little or no physical problems and their intellectual abilities remain largely unchanged. We are now aware, however, that some of these people do not go on to make the progress we would like or expect. They may not return to work, experience changes in personality and emotion, or find it difficult to make plans and carry them through. Research in other areas has suggested that these difficulties are related to poor executive functions. We wish to discover whether this is the case with people who have suffered a SAH. Being able to tell who has these problems would allow us to know who to offer treatment to, to help with these difficulties.

Why am I being asked to take part?

You are being asked if you would like to take part as you have suffered a SAH and your neurosurgeon feels you have made a reasonable or good recovery.

Will the study effect my treatment?

No, taking part in the study will not affect your treatment.

What will be involved?

You will be asked to complete a number of paper and pencil tests to assess your executive functioning. In addition, both you and a close relative will be asked to complete some questionnaires. This will take about 2 hours during a single visit to the Dundee Royal Infirmary or at your own home at a time convenient to you. Travelling expenses for this visit to the Dundee Royal Infirmary will be reimbursed. In addition, those that take part will be provided with a summary of the results of the study once it has been completed.

Can I change my mind?

Participation in this study is entirely voluntary and you are free to refuse to take part or to withdraw from this study at any time without having to give a reason and without this affecting your future medical care.

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Dundee Healthcare
NHS TRUST

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Dear Dr

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As you will be aware the above patient underwent aneurysmal surgery for a sub-arachnoid haemorrhage at the Neurosurgical Unit, DRI in
I am currently in my third year of my Doctorate of Clinical Psychology, and I am undertaking a thesis entitled "A cross-sectional study of executive functioning and quality of life after sub-arachnoid haemorrhage." Neurosurgeons at the DRI have rated your patient as having made a good recovery from their SAH at point of discharge, and in other ways they meet the inclusion criteria for this study. For each subject the study involves a single session either at DRI or their own home where they will be asked to complete a number of questionnaires as well as a relatively brief neuropsychological assessment. A close relative will also be asked to complete a number of questionnaires. Overall this should take no more than two hours. I hope to approach Mr/Mrs_____ in approximately one weeks time to see whether they wish to participate in this study and I enclose a copy of the information sheet they will be receiving for your information.

If for any reason you feel that it would be inappropriate or detrimental for this patient to be involve in this research I would be grateful if you would contact me or leave a message at the above number.

Yours sincerely,

Alan M Harper, Trainee Clinical Psychologist.